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AMERICAN MACHINIST

November 12, 1941

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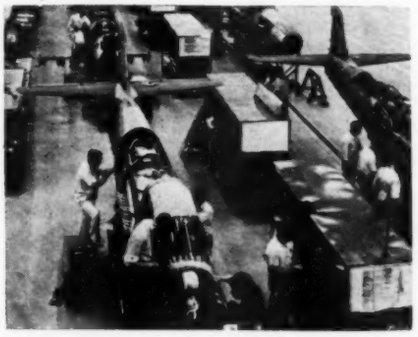

Soaring Snakes—*Bell Aircraft uses straight-line methods to speed output on its famous fighter plane, the Airacobra*

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McGraw-Hill Publishing Company, Inc.

Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42nd Street, New York, N. Y. Branch offices: Chicago, 520 North Michigan Ave.; San Francisco, 68 Post Street; Aldwych House, Aldwych, London, W.C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta.

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VOLUME 85 — NUMBER 23

AMERICAN MACHINIST. Copyright 1941 by McGraw-Hill Publishing Co., Inc. Published every other Wednesday, price 35c a copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates — United States, Canada, Mexico and Central and South American countries $5.00 a year, $8.00 for two years, $10.00 for three years. All other countries $8.00 a year, $13.00 for two years, $16.00 for three years. Entered as second class matter, September 29, 1936, at Post Office, Albany, N. Y., under the act of March 3, 1879. Printed in U.S.A. Cable address: "McGrawhill, New York." Member of A.B.P. Member of A.B.C.

A McGRAW-HILL PUBLICATION

PRINTED IN U.S.A.

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Your 1941 handbook of ideas for expanding defense production...

THE MACHINE TOOL PRODUCTION NUMBER

OF

AMERICAN MACHINIST

☆

PUBLISHED NOVEMBER 26

WHAT'S IN THIS ISSUE

MANNING INDUSTRY'S GUNS

The job of training men for industry has been intensified by large armament orders. Even companies long experienced in training men have had to adopt special methods to meet the emergency. General Motors has taken on large orders for machine guns, which means new equipment that has to be operated. How this unprecedented demand was met by the General Motors plants at Flint and Saginaw, is told beginning page 1127 in an article "Defense Workers Trained Quickly."

GEAR TOLERANCES

How good should a gear be? That question has never been answered because up until this time there has never been any standard of gear precision. However, this has been corrected in the case of spur and helical gears. A brand new standard, compiled by the American Gear Manufacturers Association, gives definite tolerances for gears. Speed, of course, is a prime consideration so there are different tolerances for different speed ranges. This standard may be found on pages 1161 and 1163.

WATCH YOUR OIL

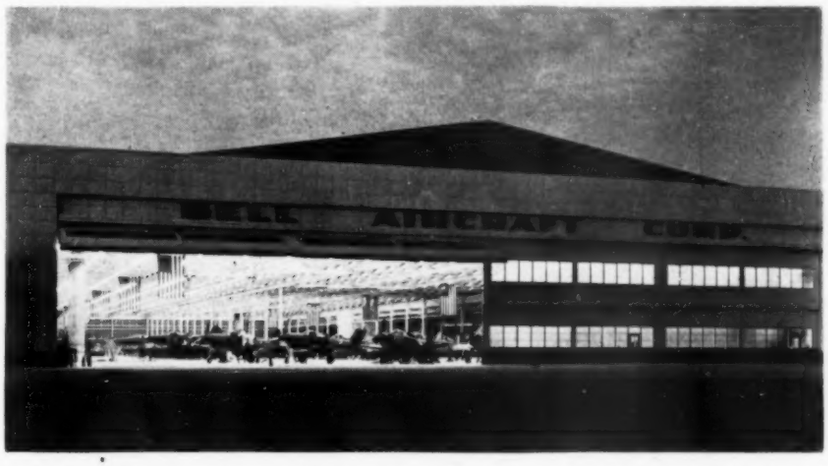
Nobody belittles the importance of good lubrication, and yet we find many shops that leave it almost to chance. They supply oil cans to their machine operators, but then neglect to see that each bearing gets oil regularly and of the proper grade. Warner & Swasey has put oiling on a systematic basis. A special group of men performs this task and does it according to a prearranged schedule and with pre-selected lubricants. Nels Swenson, the company's general superintendent, gives the details in "Lubrication Keeps Production Rolling" on page 1138.

"DRILL AT ASSEMBLY"

Machine operations on the assembly floor are not uncommon, but the Reeves Pulley Company had an unusually tough example. It was necessary to compress a heavy spring while drilling six holes around the circumference of a cover. A special fixture was designed to handle the job conveniently and economically. We pass it along on page 1141 with the thought that other shops may profit from this company's experience.

AIRACOBRA ASSEMBLY

Bell Aircraft, like others in the field, has successfully adopted line production methods to the airplane industry. It uses six assembly lines off which its special pursuit planes are now rolling at a record rate. It goes without saying that to do this required plenty of planning with attention to such details as work flow and fixture design. O. L. Woodson, general manager, Bell Aircraft Corporation, tells all about it in an article, "How Airacobras Are Built," on page 1145.



Bell's Niagara plant operates day and night on airplane production

TIME SAVERS

Short-cuts are always popular especially when they can be made at minimum expense. Right now, when time is the essence of our defense effort, practical short-cuts assume new significance. A. H. Waychoff specializes in "Short-Cuts for the Small Shop." You will find them on page 1137. This does not mean that a lot of large shops cannot find some good ideas here too.

MORE ABOUT FURNACES

The series on mechanical furnaces continues with descriptions of several additional types. These include walking-beam, shaker-hearth and semi-continuous furnaces. Here again it is pointed out that modern heat-treating involves materials handling in addition to the metallurgical procedure. This installment of "Furnaces for Production Heat Treating" is found on page 1131.

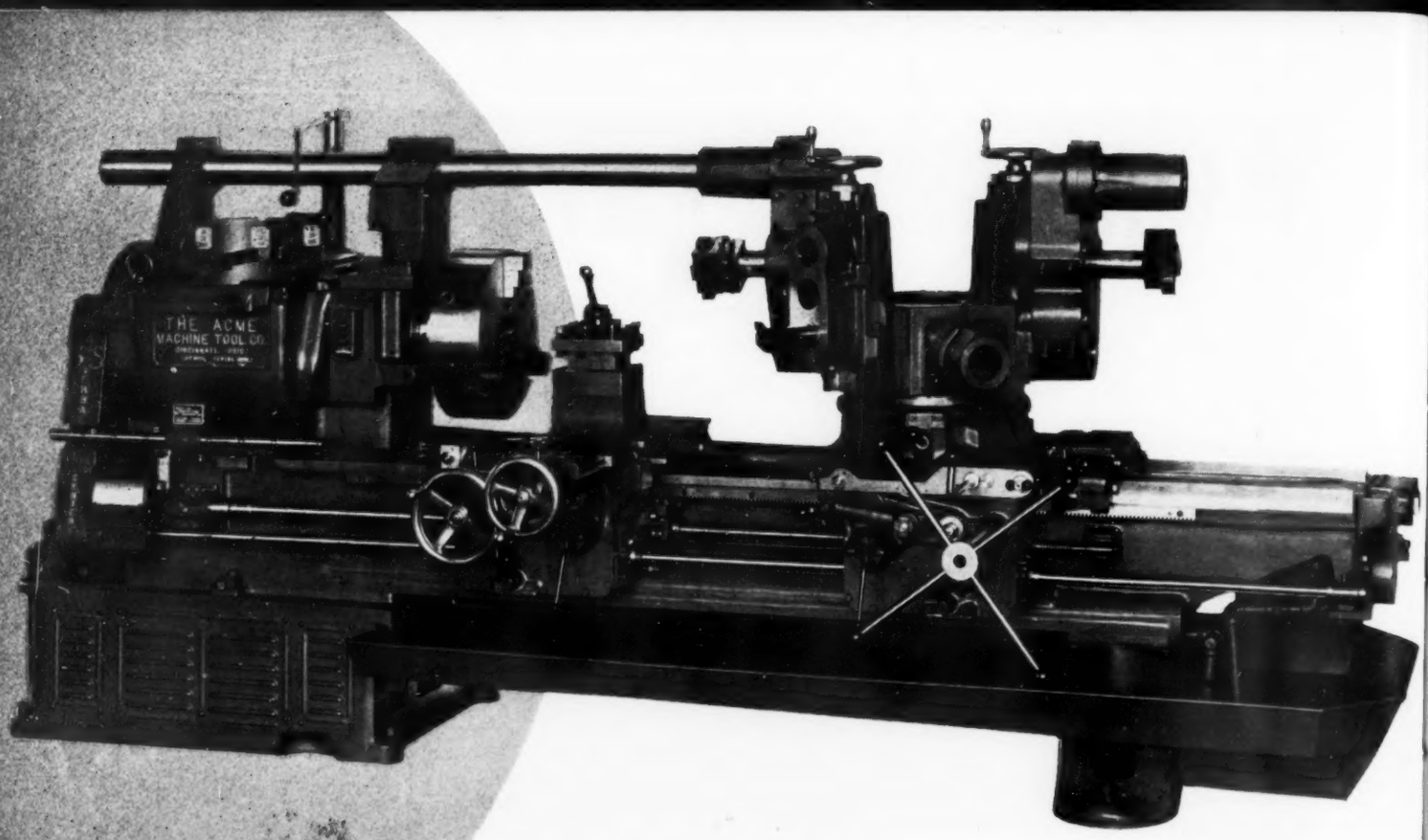
HOW TO FLAME HARDEN

J. G. Magrath, Air Reduction Company, has told a lot in his series on flame hardening about the materials that are suitable and the equipment to be used. Now he gets down to the heart of the subject and tells how to put the two together by the correct use of practical operating technique. You will find this installment of his series right to the point, giving such details as the position for the heating tip and quenching medium under a variety of conditions. Look for it on page 1134.

COMING

Not many years ago few people outside the machine shop knew what a machine tool was or cared very much. But with the advent of the emergency, the man in the street has read about machine tools in his newspaper and has become aware of their importance as the keystone of the entire metal-working industry. Most of this information has come piece-meal and we still don't believe that anyone has assembled the over-all picture of what machine tool builders have had to do and how they have done it during the past two or three years.

We are devoting our next number to the theme, "Machine Tools Fight the Battle of Production." We propose to tell the story of this industry under the stress of emergency demands. We frankly believe that the record is one to be proud of and that it marks a new milestone in American ingenuity under trying circumstances.



CINCINNATI ACME

RESPONDS TO INCREASED DEFENSE EFFORT WITH THE *NEW 3S-ACME* UNIVERSAL TURRET LATHE!

• The 3S-ACME is a machine of improved design and large capacity with abundant power and rigidity plus ample speeds and feeds to meet demands of carbide and other high production tools so necessary to speeding up defense operations.

This ACME features a stationary overhead pilot bar which not only makes for increased accuracy but for speeding up operation on jobs requiring rigid support to cutting tools. Another advantage is the safety factor, as there is no overhanging bar projecting from the turret to cause trouble for operator.

It is built in 24" and 28" Swing for chucking work and up to 4½" diameter Bar Capacity.

The ACME MACHINE TOOL CO.,
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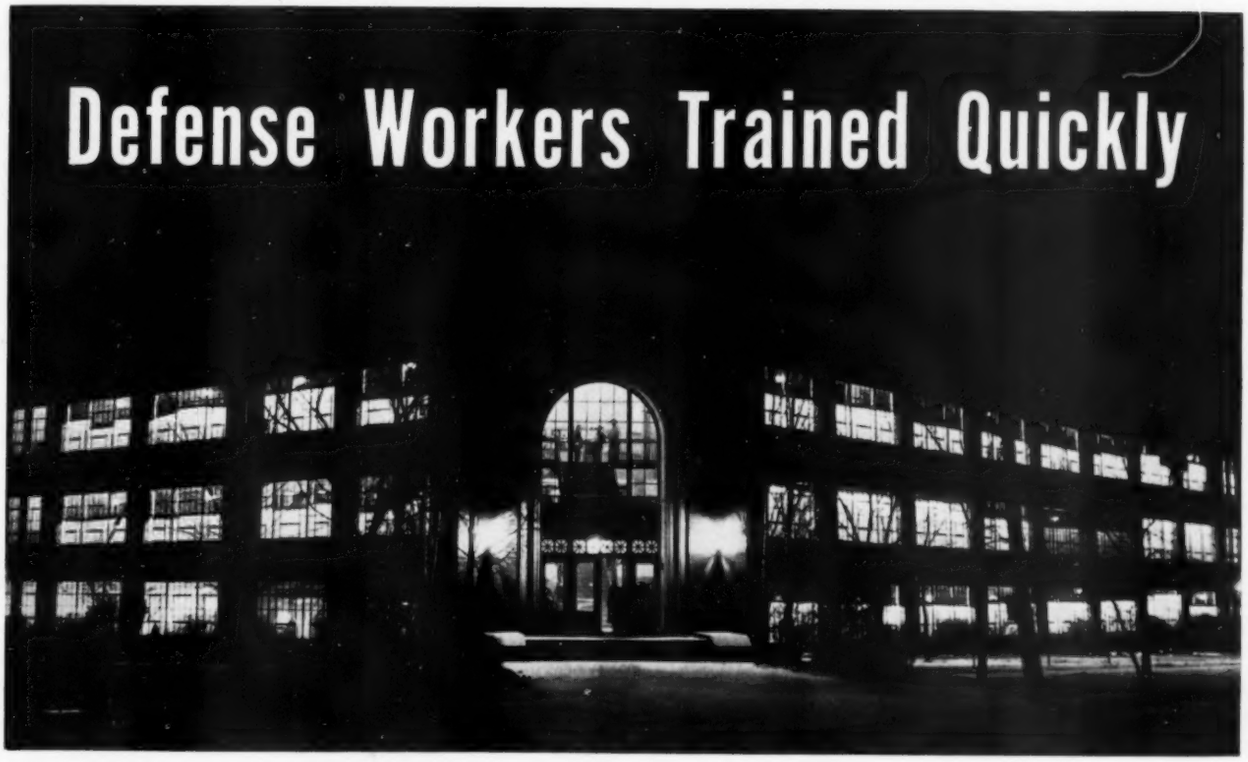
ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

Defense Workers Trained Quickly



Upon General Motors Institute at Flint rests the responsibility for developing instruction courses and procedures adaptable to rapid training of defense workers. Institute field men coach old and new foremen in teaching methods. Readymade training plans and instruction material forset-up men and operators are furnished to plant Training Departments for local adaptation

First things come first in the AC Spark Plug training plan. Foremen and set-up men are the first to be trained; then they, in turn, train the machine operators.

ONE of the most pressing problems confronting American industry is that of training machine operators, set-up men and foremen for defense tasks. In some cases, thousands of young men and women with no industrial experience must be put to work with the least delay. Under the pressure of getting into production, the usual training methods won't do. To meet the new situation, General Motors' machine-gun plants have worked out streamlined methods that meet the emergency.

From small beginnings in the spring months, the hiring curve is accelerating rapidly. By winter these plants will be in full production months ahead of the War Department's "high-pressure" schedule.

Where is General Motors getting the thousands of workers involved? What is its training philosophy? What methods are being followed to whip raw material into a factory organization? The answers to these questions are found in the practices of the AC Spark Plug and Saginaw Steering Gear Divisions, which have developed practices to suit their individual situations. In this the first of two articles we present practices developed at Flint.

Before worker training could commence in the Machine Gun Division of AC Spark Plug, it was necessary to create a supervisory organization—not top management, but a large group of foremen and set-up men who would have direct contact with and train the workers. AC knew nothing about guns, it was assigned to make them purely upon its "production know how." Building layout and procurement of machinery and tools were entrusted to skilled managers, master mechanics and engineers, who had a pattern to follow in the mass-production practices of Colt and the gun-making procedures of the arsenals. But in the field of training labor there was no precedent. Several thousand people, most of whom had no experience in industry, had to be taught in a few months. In fact, AC foresaw that it must employ from

AC Spark Plug concentrates skill in the hands of foremen and set-up men, most of whom had to be taught their jobs and trained in instructing operators. Here training supervisors and experienced foremen from G.M. plants watch a set-up man demonstrate the operator-teaching routine

40–50 percent women because of the potential labor shortage in Flint.

The training responsibility therefore took equal rank with that of manufacturing preparation, and a man with many years of experience in running plants and handling labor was assigned to the task. At the outset, it was imperative to make a decision that might have far-reaching consequences upon production efficiency in later months. The question was whether: (1) to concentrate skill in the hands of 300–400 foremen and set-up men, who would import job knowledge as needed to the expanding working force, or (2) partially to train from 3,000–4,000 workers by some means such as vestibule schools.

Foremen Receive Class Training

The 50-caliber gun assigned to AC took priority over the 30-caliber to be made elsewhere, and Flint expected to secure a good share of its equipment in seven to eight months. The training department decided to use that time for building a force of foremen and set-up men, concentrating skill in their hands and leaving to them the responsibility of imparting job knowledge to workers who would be hired with receipt of sufficient machinery to start pilot production.

This philosophy of training has two advantages: (1) the smaller group is more easily controlled, and (2) the training department would not be spreading itself too thin when the worker force assumed large proportions. It would be free to continue the training of foremen and assistant foremen, so that in time they would attain a good measure of the efficiency built up in the regular AC manufacturing departments, for it must be remembered that these foremen have been largely made on the job and many of them had little or no previous experience in manufacturing.

So last October, a half-dozen key men, the future supervisors and general foremen, were transferred to the Machine Gun Division. Each of these men was supplied with two experienced set-up men from the AC plant. It was the job of this group to familiarize themselves with gun manufacture ahead of production by repairing and modernizing 332 machine tools obtained from storage at the Rock Island and Springfield Arsenals. Tools and fixtures were fitted to the machines, jobs set up and speeds and feeds ascertained.

Each of the experienced set-up men was given two other men to train. Some of the learners were utter strangers to shop work, others had a little knowl-

To create a force of 350–400 set-up men in ten months, AC used an experienced man to break in two novice set-up men. When trained, these two men each took on the training of two more as replacements and for other shifts. Set-up men are responsible for job-setting and operator training

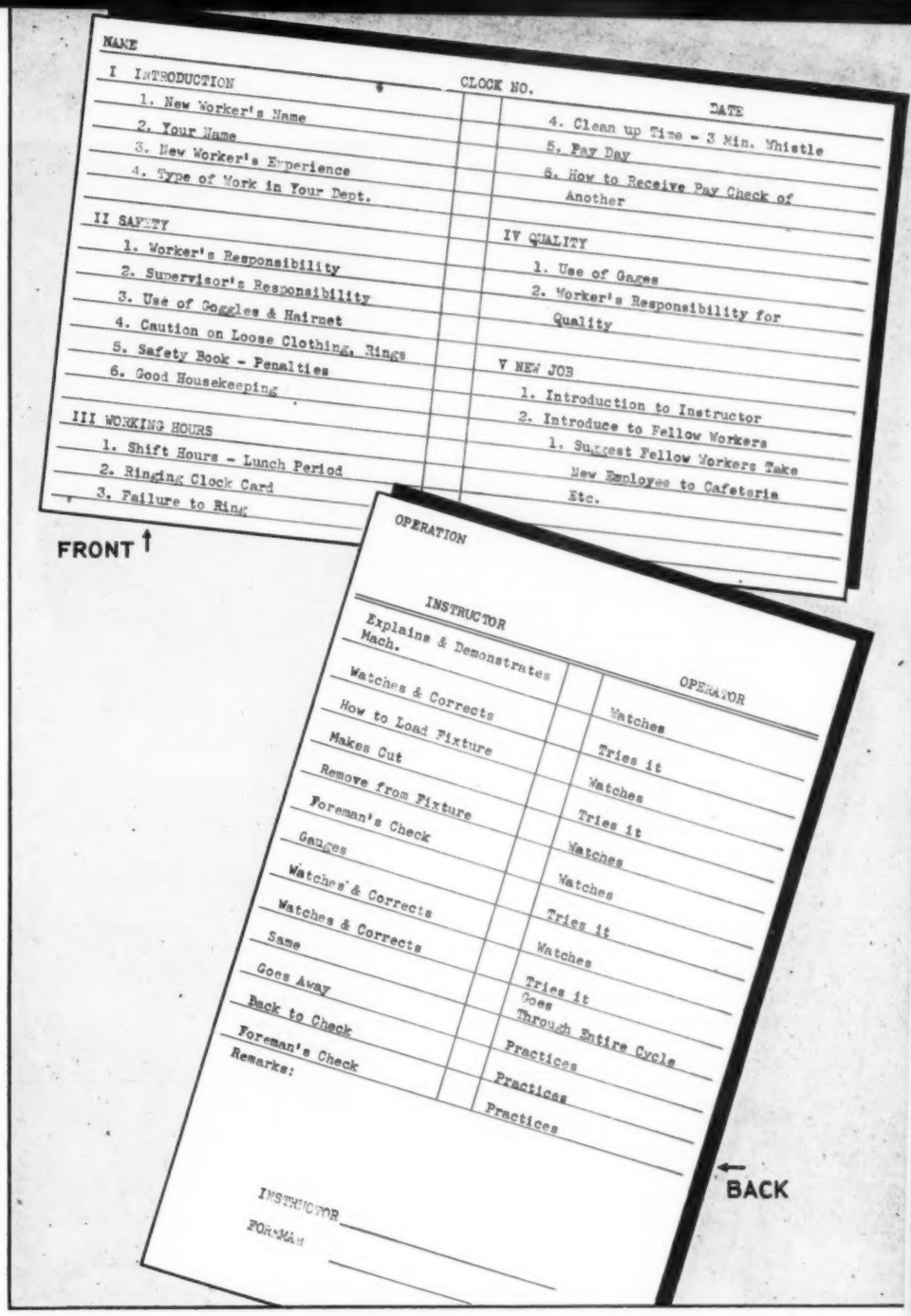
edge. When trained, the new men each took on two more learners. In this manner the number of trained set-up men was rapidly expanded to cope with multi-shift operation, and a number of foremen and assistant foremen came from their ranks. Thus by May, or seven months after the training program commenced, one major department had eighteen foremen, each of whom had an assistant. In the other major division there were two foremen and eight assistants. Operators numbered 1,800. A total of 155 set-up men were employed. By August this force was to be expanded to the full complement of 50 foremen and 350–400 set-up men, plus an operator group of 2,000. By December the employment is scheduled to reach 3,000 on a three-shift, six-day-a-week basis.

Operators Are Shop Trained

To keep track of training foremen and set-up men, the training supervisor established an organization chart for each of the two major departments. In vertical columns, representing subdepartments, he lists foremen, assistant foremen and all the set-up men, according to their status of training. There is nothing rigid about this chart. Set-up men are moved up according to display of ability, or may be shifted into other departments as the need arises. Advancement is according to merit in mechanical, teaching or organizational ability.

In the initial stages of the training program, set-up men are of major importance, because upon them rests the responsibility for job setting and teaching workers, and out of their ranks come the assistant foremen and even a large proportion of the foremen. The novice set-up man is broken in first to handle approximately six machines in the sequence of the production program of the department, not six machines of a kind. After he has mastered job setting, he is made responsible for training his replacement, and also a set-up man for another shift. Furthermore, he is required to train the operators on his machines and to inspect their work. After these tasks are accomplished satisfactorily, the set-up man is transferred to another group of machines. If his abilities permit, the process of training is continued until the set-up man is able to handle job-setting on any machine in the department.

Set-up men receive special training in classes operated by the Training Department, as well as supplementary instruction by the Flint vocational-school system in machine tools, blueprint reading and related subjects. The Training Department is primarily interested in



Set-up men make out this form for each new operator. Items are checked off as instruction is imparted, and the card serves to remind the set-up man of the teaching routine drilled into him in special classwork

teaching set-up men how to explain job requirements to learners. A definite routine of teaching is imparted, plus an appreciation of the fact that the set-up man is engaged in human relations. By constant repetition of the instruction sequence, the set-up man is taught to size up the individual, how to maintain his attention, and what points to stress so that the new employee will become a satisfactory operator in the shortest space of time. Set-up men are required to demonstrate the training method in class. The Training Department definitely attempts to convince set-up men that they are representatives of management.

Although the Machine Gun Division of AC Spark Plug expects eventually that women will make up from 40–50 percent of the working force, by early summer it had obtained over 700 male employees from the Flint vocational school system. During the school year, training in handling of machine tools was given only at night, but during the summer the program will be increased from one-third to one-half by day and night sessions. Courses vary in length up to twelve weeks. Urgently needed operators, such as profilers and milling machine operators, get less instruction, are trained on equipment loaned by the plant. Supplementary training is also

going forward. From 200–250 set-up men were receiving instruction in courses calling for four hours of work per week. While the vocational school-system cannot meet the demand, it expects to train up to 2,500 workers by mid-winter. Girls are being considered for training in the vocational-school system.

Worker Induction

Workers certified by the school system or obtained via the employment department are turned over to the time department for induction into the plant —a step of real importance in overcoming strangeness to an entirely new type of surroundings and making the new employee feel that he or she is of importance. The time department representative points out the time clock, shows how to ring it, locates locker and comfort facilities, finally introduces the learner to the department foreman. If the foreman cannot immediately assign the newcomer, the reason is carefully explained and reading matter provided. When the learner is taken to the assigned machine, he is introduced to the set-up man who will take over the actual training.

Worker Training

After preliminary conversation designed to set the new employee at ease and to ascertain the type of person he is and therefore the best approach, the set-up man commences training by reference to the card maintained for each worker. Subjects discussed first are: safety, plant rules, the use of gages and the worker's responsibility for quality. An opportunity is also made to introduce the new employee to adjacent operators.

Job training is undertaken by reference to the items listed on the reverse side of the card. The set-up man has been thoroughly drilled in the teaching routine by means of the specialized classroom work mentioned previously. This card serves to refresh his memory, prevents overlooking vital details, becomes a record of the employee's progress. Note that the foreman must check the card twice in the early stages of the training procedure.

In effect the new operator is required to learn four essentials: (1) how to work safely, (2) how to operate the machine, (3) how to load and unload the work, and (4) the use of gages. The most difficult feature in training new operators is apparently that of getting them to use gages constantly. From experience with the class of girls employed, most of whom are high-school graduates, it is found that many operators become "old hands" in a few hours. Repeatedly, as many as twenty girls have been placed into a department at the start of a shift and absorbed before the day is out. Operators are not expected to change tools. If they suspect something is wrong or the part is not to size, the set-up man is called.

Vocational and trade schools in Flint and Saginaw will pre-train at least 50 percent of operators required in local machine gun plants. Profilers were loaned to the schools and instructors provided so that a steady stream of pre-selected youths will meet the rising need for this type of skill in production departments

Foreman Training

Foremen, assistant foremen and heads of departments are given three streamlined courses. The first involves eight sessions of 1½ hr. per week in the general principles of foremanship. This course was written by the General Motors Institute. Additional sessions cover labor relations, plant policies and procedures. Groups consist of 20–25 persons and instruction is given by the conference method. Experienced foremen attend these meetings for "refresher" purposes and to assist the green men in the give-and-take of discussion. Demonstrations are made periodically of instructing a new operator, the foremen acting out the parts. This procedure serves to stimulate their interest in the program, to sharpen their teaching ability. Most of the foremen and their assistants have already had the specialized instruction given to the set-up men. Foremanship training will be continued indefinitely, with the purpose of bringing the foreman up to the level of efficiency in the AC Spark Plug Division.

This system was modified considerably at the Saginaw Steering Gear Division plant, because vocational training has been a strong feature of the Saginaw school system for years. In the next article, the practices developed at Saginaw will be presented.

The second part of this article will appear in an early number.

Furnaces for Production Heat-Treating

BY RUPERT LEGRAND, DETROIT EDITOR, AMERICAN MACHINIST

3—The round-up of heat-and-move heat-treating equipment goes on with descriptions of walking-beam, shaker-hearth and semi-continuous furnaces

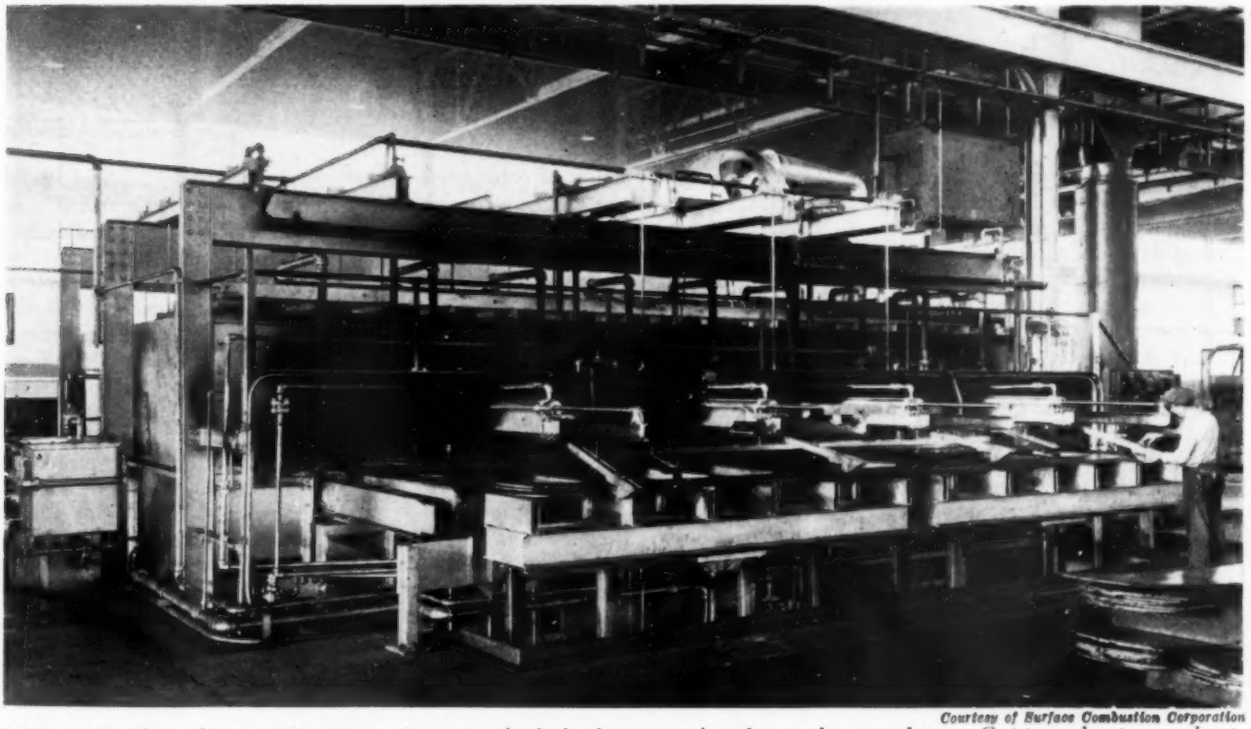
ALTHOUGH the principle of the walking-beam furnace affords a number of advantages in heat-treating bulky or heavy load on a tonnage basis, its acceptance by industry languished until recently. In the days before heat-resistant alloys could be designed into furnace parts with predictable results, warpage of the walking-beam mechanism gave trouble. Modern walking-beam furnaces are precision heat-treating machines. Current uses include heat-treating and annealing ferrous and non-ferrous plate, processing automobile leaf-spring assemblies and cylinder liners, and heat-treating shell.

The walking-beam furnace derives its name from the nature of the mechanical movement utilized to move the work through the heating chamber. Walking beams are disposed between stationary beams running lengthwise of the hearth. By means of suitable linkages, driven by exterior means at the charging end of the furnace, the walking beams are caused to move in a rectangular path: (1) upward, lifting the work from the stationary beams, (2) forward toward the discharge end of the furnace, (3) down, depositing the work on the stationary beam, and (4) back to the starting position. Beams can be made to suit the contour of the work, and the mechanism can be arranged to prevent scratching highly polished work as it is picked up by the walking beams or dropped on the stationary beams.

There are no physical limitations for hearth dimensions in walking-beam furnaces, either in width or length. Steel-mill installations use hearths up to 90 ft. wide. Work of different sizes can be processed simultaneously. In shell plants, for example, four rows of large shell may be handled on one part of the hearth, and eight rows of smaller shell on the remainder. In other words, it is possible to design a furnace to handle several bulky or heavy work pieces according to the relative quantities and dimensions of each size.

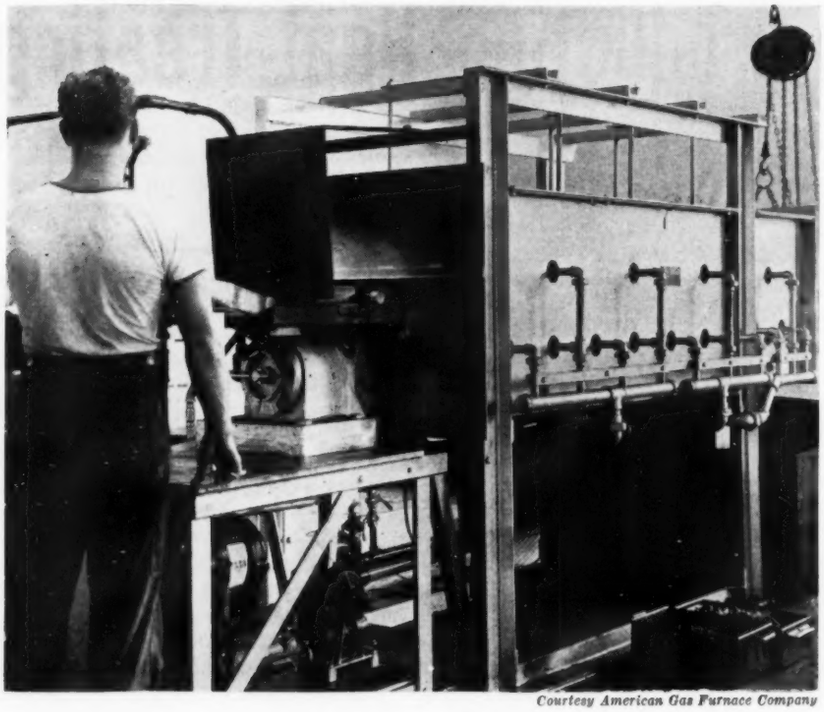
Unit loadings for walking-beam furnaces reach 150 lb. per sq. ft. of projected hearth area, a figure which exceeds permissible loadings for other types of continuous furnaces. Work speeds may reach 90 ft. per min., depending upon the weight and size of the work, and the mass of the walking beams necessary to effect travel through the furnace. The speed of the walking beam mechanism can be varied to suit heating time for various kinds of work.

Compactness is achieved in walking-beam furnaces because the mechanism does not project beyond the side walls. Avoidance of heat loss from exposed



Courtesy of Surface Combustion Corporation

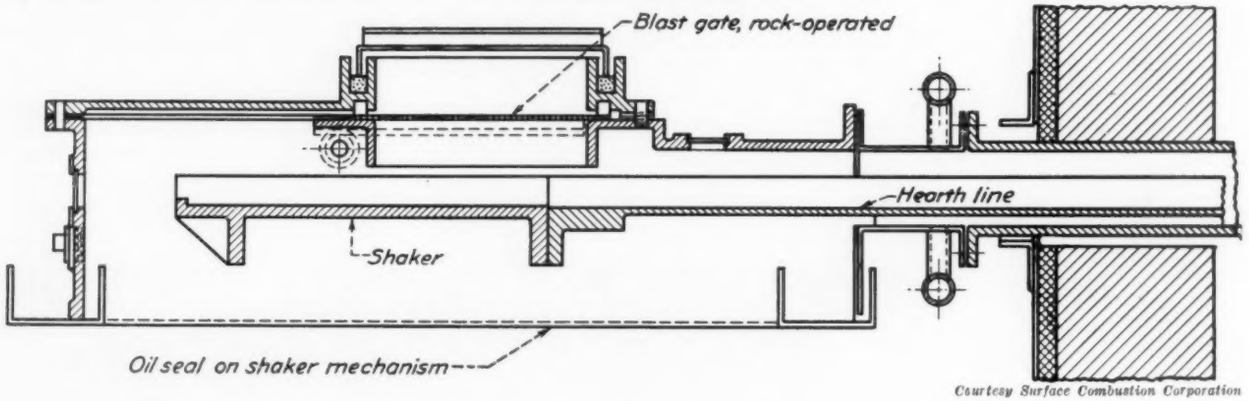
Mill applications for walking-beam furnaces include heat-treating large, heavy plates. Copper sheets are heat-treated and quenched in this installation; brass sheets heated to ease the strain of rolling. Note the completely automatic loading table which delivers one sheet or plate at a time to the walking-beam mechanism



Courtesy American Gas Furnace Company

Three hundred pounds of capscrews are clean-hardened per hour in this "reciprocating - hearth" heating machine

To prevent dilution of protective atmosphere or deleterious effect of air ingress while charging the work, the blast-gate feed has been developed for shaker - hearth furnaces. The cover is removed, a load placed on the blast gate, the cover replaced, and the rack-operated blast gate moved rearward, thus allowing the load to drop on the shaker tray



Courtesy Surface Combustion Corporation

mechanism is a byproduct of this construction. Walking-beam furnaces need not be run while being heated up or cooled down to prevent damage to the mechanism from unequal expansion. The beams may be likened to the tines of a fork, and contact and expand uniformly if properly designed. Effective operating time during the work week need not be sacrificed while operators run the equipment during heating up and cooling down, nor is it necessary to have maintenance crews watch the equipment during these periods.

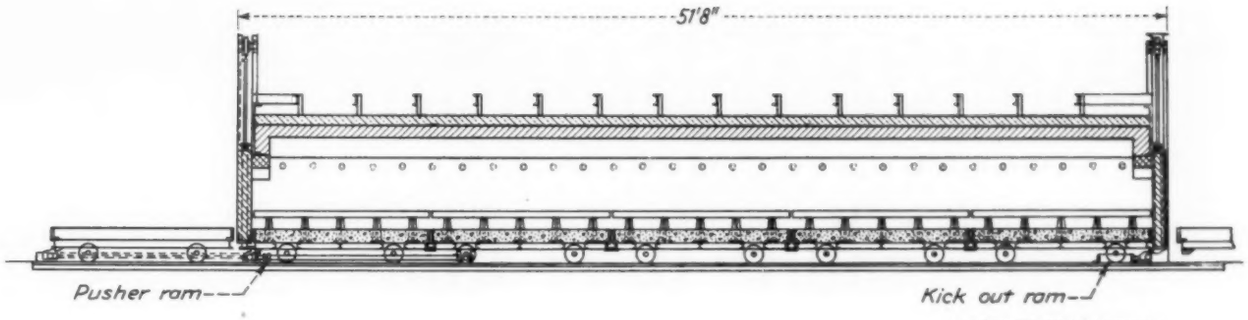
SHAKER-HEARTH FURNACES

Shaker-hearth furnaces are currently built to handle work from extremely small items to forgings and other parts weighing several pounds. These machines are equipped with a tray-type hearth that extends from the front of the furnace to form a loading tray, or with a closed muffle that protects the work from the products of combustion and in which positive atmospheric control can be maintained. By means of a suitable mechanism the hearth or muffle is reciprocated. At the end of the forward stroke, motion of the hearth is suddenly arrested, and the work advances under its momentum. Length of stroke, number of strokes per minute and their force can be varied to suit the work being processed, the load and the process involved. Thus, a shaker-hearth furnace is not a single-purpose machine, but can be utilized for heat-treating a wide variety of items in the user's plant. For this reason the capacity rating of a given size of furnace is expressed in wide limits.

Clean hardening, annealing and special case-hardening processes can be performed with shaker-hearth furnaces. Work can be dropped into a quench chute at the end of the heating chamber, or caused to pass into a cooling zone filled with portective atmosphere, or discharged to the atmosphere. Bright hardening and annealing and elimination of oxide finish or tarnish can be achieved as desired.

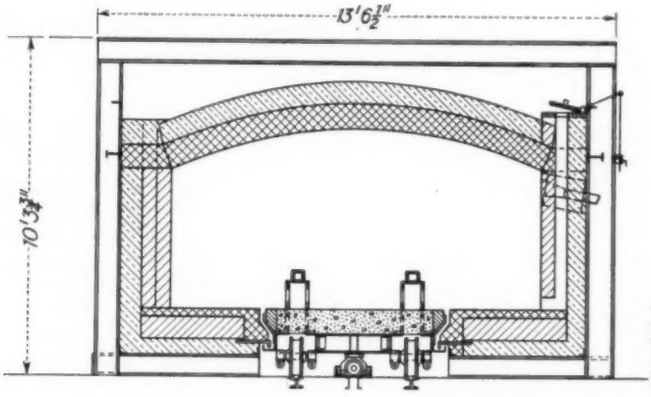
Operating labor is comparatively nil because work is dumped or spread at intervals on the semi-muffle hearth extension, or into a blast-gate feed mechanism in the case of full-muffle machines employing a protective atmosphere in the muffle. Quench tanks can be equipped with conveyors for transporting hardened work to washing equipment.

Small items such as pen points, pivots, instrument parts, lockwashers, spring clips are conveniently hardened in a shaker-hearth furnace because they are dispersed on the solid hearth and cannot catch as would be the case with a belt. Long coil springs may be put through the furnace on trays to prevent bending the hot work when it is quenched. The trays in this case slide down a 45-deg. chute and are quenched

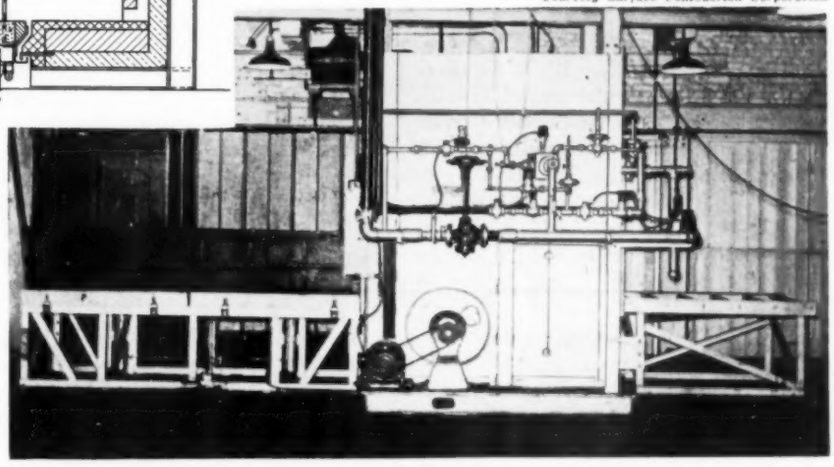


Courtesy Holcroft & Company

Cast-steel side frames and bolsters are annealed in this semi-continuous car-type furnace, which has a capacity of 10 tons per hour. Tank parts have been heat-treated in the same equipment



Courtesy Surface Combustion Corporation



Copper and brass are annealed in baskets, which are pushed manually through this semi-continuous convection-heated furnace. The installation is equipped with a roller-hearth charging table, conveyor, and discharge table

with the work. Flat parts, such as space bands for type-setting machines, are hardened without distortion. Work need not be thinly spread for hardening, since 1⅝-in. balls are being loaded solid on the hearth. Rifle receivers, weighing 3 to 4 lb., are currently hardened by arsenals in this type of equipment, and defense contractors are employing them for hardening 37-mm. shell.

In the annealing of small brass cases, the work is put through the heating machine in deep layers almost filling the muffle. Steel parts can likewise be annealed in deep layers, the work being brought to temperature and the gas flow in the muffle maintained while the work cools over night.

Repairs are a comparatively small item with shaker-hearth furnaces. The alloy muffle is made of sufficient gage to handle the range of work which a given manufacturer will process, and the shaker-hearth is within the furnace at constant temperature and therefore not subject to deterioration arising from continual heating and cooling.

Shaker-hearth furnaces are compact, and they are built in a number of sizes. Small equipment capable of processing 35 to 75 lb. per hour requires floor space of only 3¾ x 8½ ft., while with a floor space of only 5 x 15 ft. larger equipment will turn out from 100 to 250 lb. per hour. Machines have been built to handle up to 1,200 lb. per hour.

SEMI-CONTINUOUS FURNACES

Semi-continuous furnaces consist usually of a rectangular chamber into which work is periodically charged on cars or pushed ahead on rails by a feeding mechanism, such as a charging crane. Entrance of a new charge forces work already in the furnace through various heating zones such as heating, soaking and cooling in the case of annealing operations or through heating and soaking zones prior to quenching. Movement through heating zones is the characteristic which distinguishes a semi-continuous furnace from a batch furnace. In the batch furnace, of course, the work remains stationary and heating and cooling are under a controlled time cycle.

Bulky work, such as car wheels and strip in heavy coils, are commonly heat-treated in semi-continuous furnaces. In a recent installation for car wheels, two furnaces 8 ft. wide by 64 ft. long are placed side by side. Car wheels pass through the first furnace for hardening, and then are mechanically transferred from the quench to the drawing furnace, finally emerging near the point of origin. The complete time cycle may range from 5 to 8 hr. or even longer. There is no limitation on the size of semi-continuous furnaces.

Part 4 of this article will appear in an early number.

OXYACETYLENE FLAME HARDENING—11

How It Is Done

COMPILED BY J. G. MAGRATH, APPLIED ENGINEERING DIVISION, AIR REDUCTION COMPANY

To get the best out of flame-hardening, the correct procedure must be followed. Here are a few suggestions that may be of help

IN DESCRIBING flame-hardening procedures, it necessarily follows that there may be other methods, proved by individual usage, that have provided equal satisfaction. The commonly known and generally accepted rules for accomplishing good results with economy are those herein outlined.

The flame-hardening process may be applied either manually or mechanically. Parts with limited areas to be hardened may be surface heated above the critical temperature using a standard welding torch and a sufficiently large heating tip; the entire area is brought to the required heat by manipulating the torch back and forth across the surface. The torch is then removed, and the surface is quenched as desired.

The operator should preferably have a knowledge of furnace heat-treating and be capable of adapting his heat-treating experience to flame hardening. He should be able to determine the proper time cycle of the heat period and to judge surface temperature by the color of the heated object. All irons and steels are quenched from a fairly bright red surface heat, the surface temperatures differing according to the critical range of the particular analysis iron or steel being flame hardened. The light of the flames makes the metal appear colder than its actual temperature and must be taken into consideration when heating.[6]

The flame should be adjusted to neutral for normal operation. In confined grooves and corners, however, a slightly oxidizing flame may be necessary to

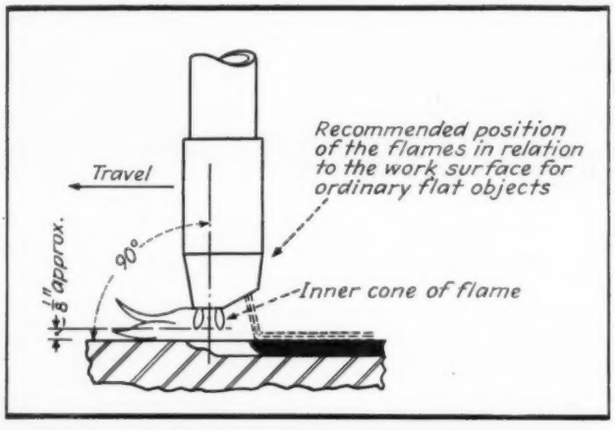
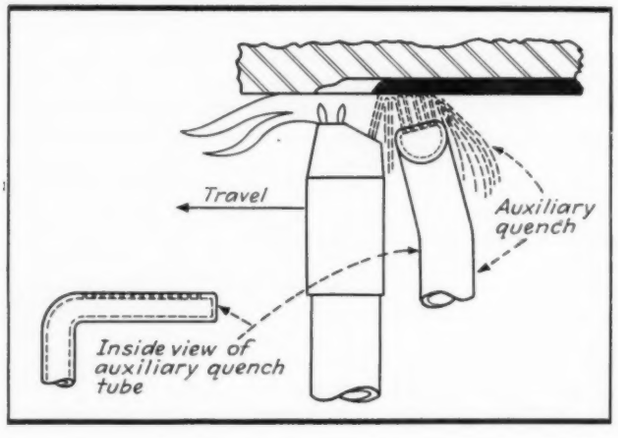
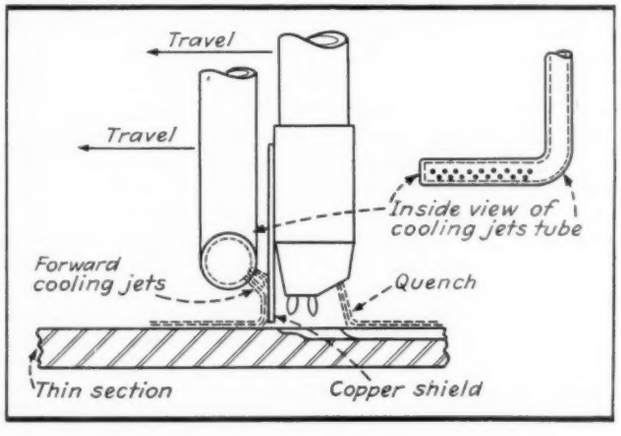

Recommended position of the flames in relation to the work surface for ordinary flat objects
Travel
90°
1/8" approx.
Inner cone of flame

Fig. 33—The position usually recommended for the heating tip is $\frac{1}{8}$ in. from the work at a 90-deg. angle

Fig. 34—Auxiliary quenches are sometimes advisable particularly when the work is overhead and the integral quench falls away

Fig. 35—On some thin sections an auxiliary quench ahead of the flame may be advisable





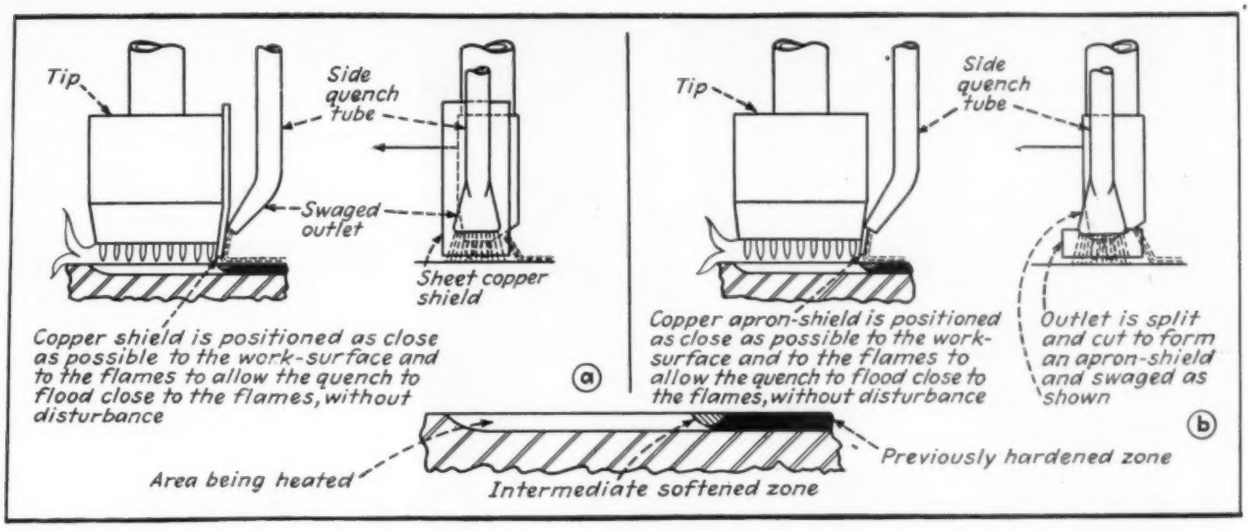

Tip
Side quench tube
Swaged outlet
Sheet copper shield
Copper shield is positioned as close as possible to the work-surface and to the flames to allow the quench to flood close to the flames, without disturbance
a
Tip
Side quench tube
Copper apron-shield is positioned as close as possible to the work-surface and to the flames to allow the quench to flood close to the flames, without disturbance
Outlet is split and cut to form an apron-shield and swaged as shown
b
Area being heated
Intermediate softened zone
Previously hardened zone

Fig. 36—Side quenches prevent softening of the previously hardened surface in progressive flame hardening

prevent flame sputter. In such instances care must be exercised not to overheat the surface.

As mentioned in a previous article, Henning and Tingwaldt, in their careful investigations on the temperature distribution of the oxyacetylene flame, found that the maximum temperature prevails at a point located 0.12 in. from the inner cone of the flame. As the length of the inner cone will vary according to the size of the orifice and the pressure employed in the tip, no satisfactory rule can be established for measurement of distance between tip face and work.

However, regardless of such variables, approximately $\frac{1}{8}$ in. between the work surface and the tip of the inner cone of the flame can be generally recommended. See Fig. 33. This distance may be increased to provide a less intense surface heat when hardening surfaces with fine projections or for obtaining exceptional depths of hardness at slow speeds.

Dark streaks occurring on the surface of the object being hardened denote overheating, generally caused by holding the flames too close to the surface. Increasing the distance between flames and object will generally provide correction.

Speed of torch travel will vary, as previously indicated in Table X (*AM* —Vol. 82, page 917), according to the depth of hardness, with consideration for the metal analysis and the thickness and shape of the object.

The angle at which the flames strike the surface is not too critical. If necessary, it may vary as much as 30 deg. (with some loss of speed) from the vertical. Spaulding has found his best results in flame hardening roller paths by sloping the tip about 3 deg. ahead

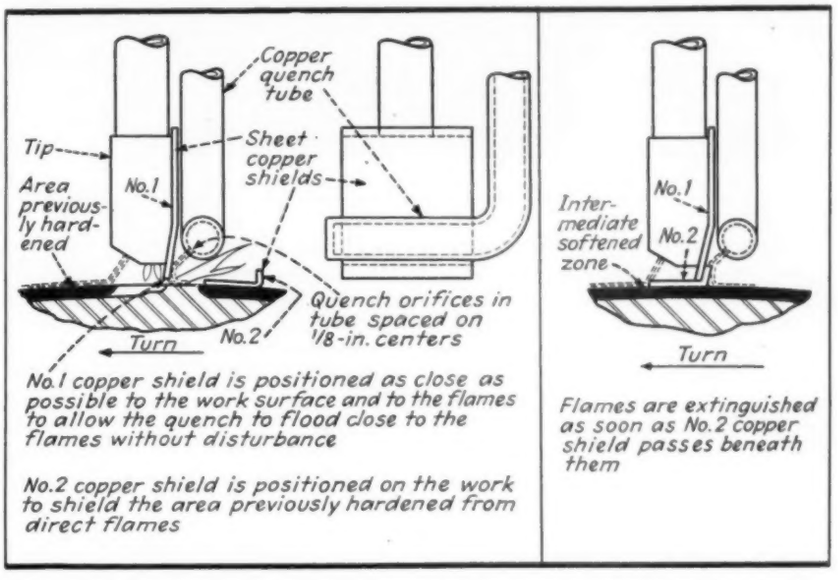

Copper quench tube
Tip
Sheet copper shields
Area previously hardened
No.1
Quench orifices in tube spaced on 1/8-in. centers
Turn
No.2
No.1 copper shield is positioned as close as possible to the work surface and to the flames to allow the quench to flood close to the flames without disturbance
No.2 copper shield is positioned on the work to shield the area previously hardened from direct flames
Intermediate softened zone
No.1
No.2
Turn
Flames are extinguished as soon as No.2 copper shield passes beneath them

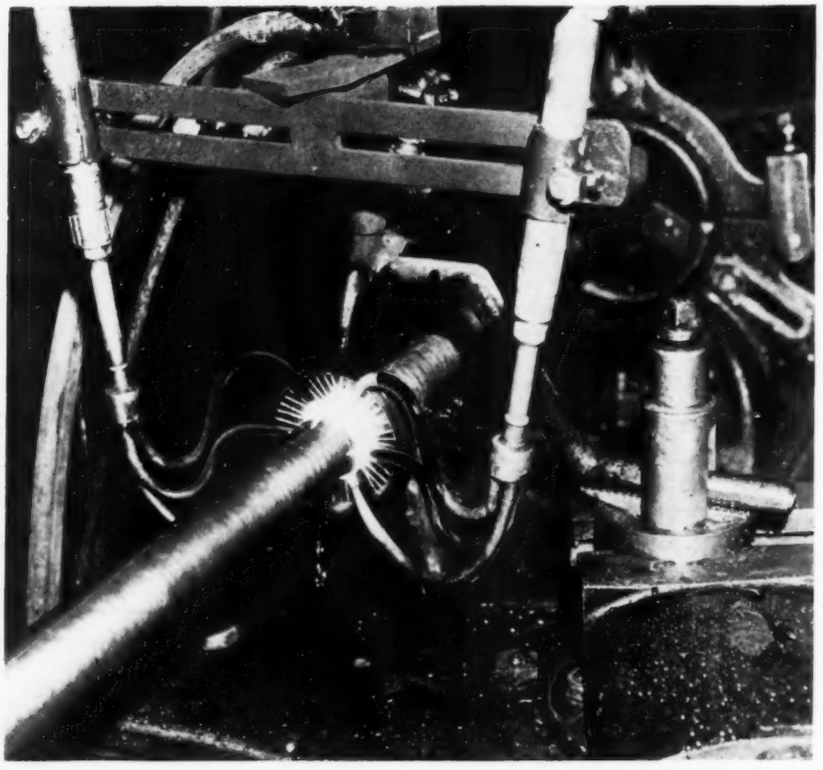
Fig. 37—For protecting the work area previously hardened in a circumferential path, the quenches and shields are arranged as shown

of the vertical. The general practice is to project the flames at 90 deg. to the surface to obtain the greatest heating efficiency. Therefore, all procedures hereinafter described, will assume the 90-deg. flame impingement, unless otherwise stated.

Standard multi-flame hardening tips may ordinarily be operated in any position, horizontally, vertically or at any angle to suit the condition of the work, without affecting their heating efficiency. The position at which the tip is operated, however, will determine the amount of quench medium necessary to quench properly the surface being flame hardened.

When operating at their normal position, that is with the work horizontal and the flames projecting downward, the built-in quench streams in the integral flame hardening tips usually provide sufficient volume to quench the heated metal to below the temperature at which it will draw, inasmuch as the surface is continuously covered with water. But when the same tip is operated with the flames projected upward upon an overhead horizontal surface, the quench volume may not be sufficient to quench the heated surface fully below its drawing temperature, as the water only strikes the surface and immediately falls away. Consequently it may be necessary to provide an auxiliary water quench and thus maintain sufficient projected quench volume against the surface to produce total quenching as shown in Fig. 34.

The standard multi-flame hardening



For limited quantities *standard welding equipment may be used with improvised fixtures on regular shop machines. For instance, a 2-in. pump plunger is shown with a ⅛-in. wall thickness on which a hardened depth of 1/10 in. was desired. The plunger is mounted on a lathe, one end chucked and the other in a steadyrest. Two standard welding torches, each carrying a three-flame tip, are held in a fixture mounted on the toolpost. The tips are bent to form a complete band of flame around the plunger. A shop made quench ring encircles the plunger a short distance behind the flames. A pan beneath catches the quench water. The plunger is revolved at the rate of 1000 in. per min. while the torches and quench are fed horizontally. An auxiliary quench may be used inside the hollow plunger to prevent complete hardening through the full wall thickness.*

tip with integral heating and quenching unit is satisfactory for nearly every kind of application. Generally the mass of the material in the subject is of sufficient volume to dissipate the heat throughout the metal without increasing the temperature of the material forward of the heating flames during the hardening operation.

Where objects of relatively thin cross-section are to be flame hardened on one side, however, to prevent the heat from conducting too rapidly forward of the heating flame, it may be necessary to place an auxiliary cooling jet in front of the heating flames as shown in Fig. 35, and provide a copper shield between cooling jets and flames. As the forward cooling jets maintain the metal forward of the heating flames at a constant temperature, the heat is localized between the cooling and quenching streams, resulting in a narrow heat band and consequent reduction in distortion in thin sections.

In progressive flame hardening, where the area being flame hardened joins an area previously hardened, an overlapping occurs accompanied by a drop in hardness frequently of 20 to 40 points Brinell on a very narrow width. Such intermediate soft zones will occur along the edges of parallel hardening paths on both flat and circular objects, and, across the path, when a complete circumference has been made on a circular object.

Control of Overlap

As the flames progress, areas adjacent to the zone of metal heated above the critical temperature will be below this temperature. A loss in hardness occurs. As it is impossible to eliminate this condition in progressive flame hardening, methods are employed to overcome or minimize any ill effects it might cause.

By confining the outer heating flames with suitable shields, a sharp temperature gradient can be maintained between the path being heated and the zone previously hardened, materially reducing the width of the softened area, frequently to as little as $\frac{1}{16}$ in.[4]

On the parallel sides of straight and circular hardening paths the intermediate softened zone may be narrowed by means of the copper shield and side quench tube as shown in Fig. 36 *a* or with the aproned side quench tube detailed in Fig. 36 *b*. These are affixed to travel alongside of the flames, fitting closely to the surface and providing a water quench playing upon the edge of the previously hardened path.

A means of effecting the steep temperature gradient at the end of, and across, the circular path is indicated in Fig. 37. The previously hardened area is shielded with copper and a copper quench tube provides a water quench over the width of the path along the edge of the previously hardened area.

As a rule, the overlap is not detrimental, in that the intermediate softened zones are narrow and interspersed with wide bands of maximum hardness which carry the load and provide for wear. In hardening higher carbon or sensitive alloy steels, the effect of heating an already hardened area will inevitably cause checking. Therefore, in such cases it is desirable to provide purposely for a soft zone between hardened paths.

Where the overlap is objectionable on round surfaces of medium diameter, the band spinning or progressive spinning method should be employed. On flat surfaces overlapping can be frequently avoided by grouping sufficient heating tips to cover the desired width of path to be hardened. The only limitation is the greater amount of equipment required, which would be justified in production hardening.[4]

The next installment of this series will be found in an early number.

BIBLIOGRAPHY

4. Notes on Flame Hardening, by G. V. Slottman, July, 1940.

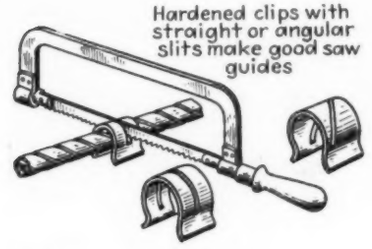
6. Report of Stephen Smith, Subcommittee on Flame Hardening, American Society for Metals, January 16, 1939.

SHORT CUTS FOR THE SMALL SHOP

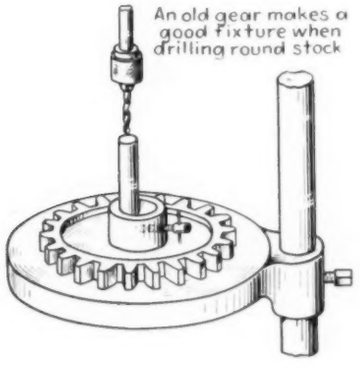
BY A. H. WAYCHOFF

A needle in an automatic pencil makes a good scriber

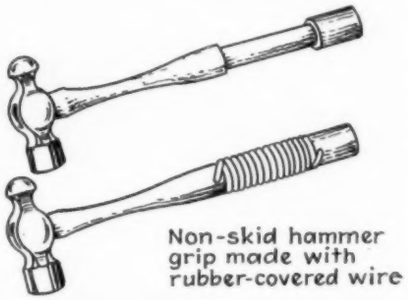
SIMPLE SCRIBERS can be made from an automatic pencil and darning needle. Take a large darning needle the same diameter as the leads used in the pencil and snap it off near the center of the eye. If the pencil is not the type that has a flattened end on the wire that controls the leads, file the end of the wire flat and push the needle eye against it. The needle will stay in place and can be operated in and out like a lead. Any length of needle can be run out for the work at hand.



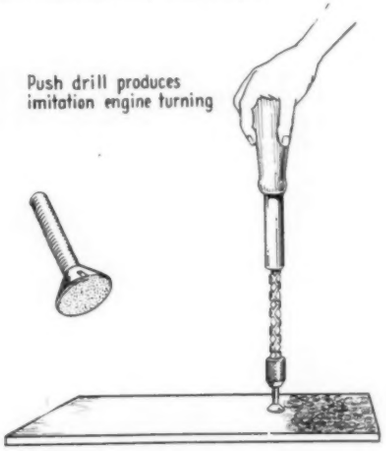
SQUARE CUTS, as well as angular ones, can be made in tubing or BX cable by making spring clips in which slots have been cut to guide the hacksaw. It is necessary to draw the temper of the spring material, cut the straight or angular slits for guiding the saw, bend it to suit the diameter of the pipes to be cut, and retemper it. A heavy phonograph spring is suitable for making these clips. They should be shaped so they can be slipped on the end of the pipe, and have sufficient tension to prevent slipping while making the cut.



DRILLING of small parts such as rods and pins can be done easily by holding the part in an old gear. Take the gear, true up the hole and replace the setscrew with a thumbscrew; also, face off one side of the gear so it rests squarely on the drill-press table. Round work can be set in the shaft hole, forced against the wall with the thumbscrew, and centered under the drill. The gear can be clamped readily in that position.



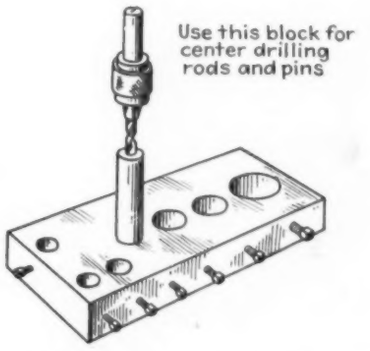
HAMMER HANDLES wrapped with rubber-covered wire will make an excellent grip, especially where tools are used on work covered with oil and grease. A ring is cut around the handle of the hammer, as wide as one would want to make the grip, and at a depth equal to one-half the diameter of the wire to be used. Small holes drilled at each end of the channel portion of the handle will retain the wire at the beginning and end of the wrapping. The rubber covering furnishes a soft comfortable grip, while the heavy copper wire will cause it to hold its shape and not become soft and loose.



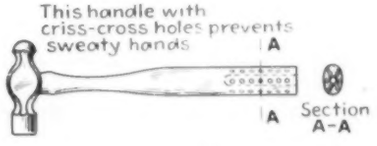
IMITATION ENGINE TURNING can easily be done with the help of a push drill, machine screw and emery disk. Cement the disk on the screw head, clamp the screw in the drill, and you're ready to work. At each push the drill is set over a little, so the circles formed by the emery will overlap a bit. Many different types of surfaces can be made by changing the grade of emery and the amount of overlap.

The coiled wire radiates heat - prevents burned handles

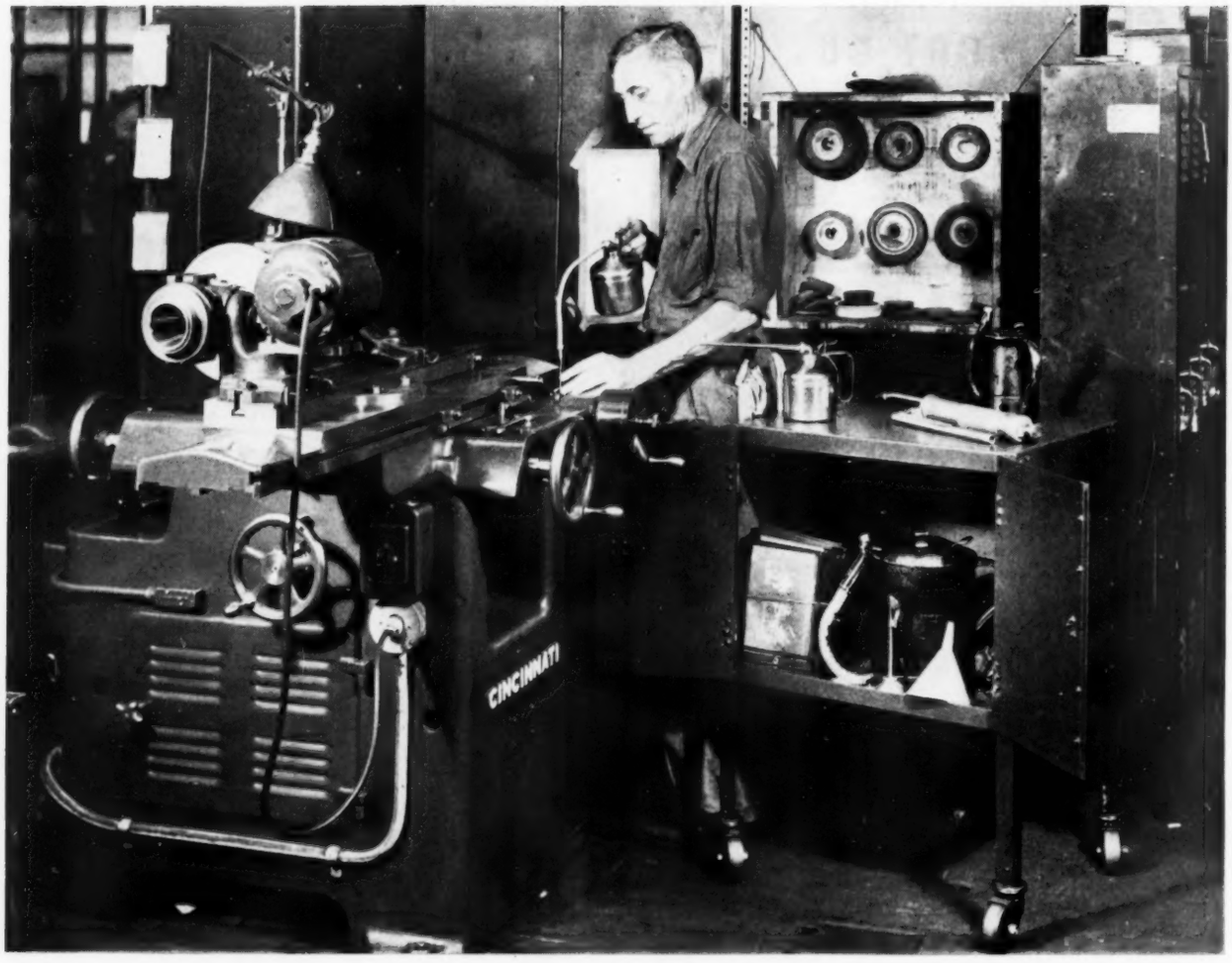
NO BURNED HANDLES will be found on soldering irons if you coil heavy copper or aluminum wire on the shank between the iron and the handle. The copper or aluminum will radiate the heat before it reaches the handle, keeping the handle tight and always comfortable to grip. The wire should be wrapped tightly. Holes for retaining the wire can be drilled in the shank close to the iron and under or near the handle.



DRILL BLOCKS for bench drills are needed to drill holes accurately in the ends of small rods. Make one by taking a steel bar of proper dimensions, face the bottom so it will rest squarely on the drillpress table, and drill vertical holes in the block in the step sizes required; for example, from $\frac{1}{8}$ to 1 in. in $\frac{1}{8}$-in. steps. Drill and tap horizontal holes to each of the vertical holes for setscrews. When ready to drill a hole in the end of a rod, place it in the proper hole in the block and tighten the setscrew to prevent it from turning under the action of the drill. Similar blocks can be made for square and hexagonal stock.



BREATHING HAMMER HANDLE can be made by boring a $\frac{1}{4}$ or $\frac{5}{16}$-in. hole in the end of the handle, and drilling $\frac{1}{4}$-in. holes around the circumference. The end hole should be at least 6 in. deep. This prevents the handle from slipping out of sweaty hands. Also, hands have less tendency to sweat when gripping a hammer handle so drilled. This idea can also be applied to sledge handles.



Each lubrication man has a steel cabinet, mounted on casters, in which he keeps his oil cans, funnels, grease guns, special oils, and copies of lubrication charts for all machines in his care

Lubrication Keeps Production Rolling

BY NELS SWENSON, GENERAL SUPERINTENDENT, WARNER & SWASEY COMPANY

Here is a workable solution to the problem of keeping our industrial equipment running in spite of the tendency of new men to forget to oil their machines

IN JULY 1940, when the National Defense Emergency was declared, the Warner & Swasey Company had already been operating 24 hours a day for 20 months. The need for a more adequate "lubrication control system" became evident through an increasing amount of machine break-downs. Repairs were costly and valuable machine production time was lost.

Under the old system, the machine operators were responsible for the lubrication of their machines. An adequate supply of oil was kept in each department for the men to use. However, with three-shift operation, the expansion of our plant, and the influx of large numbers of new men, the lubrication of machine tools was neglected entirely or not adequately performed. A contributing factor to the laxity of the operator to lubricate his machine is that modern machine tools have definite specifications on lubrication and as many as five different lubricants are used on many machines. The ordinary mechanic does not understand lubricants and often used the wrong kind—resulting in a break-down or rapid loss of accuracy of a machine due to wear.

It was decided to hire men who would do nothing but lubricate machines. Our experience shows that one man can take care of the lubrication of approximately 100 machine tools. In

addition to revising the system, a thorough check was made into the lubricants which we carried in stock. Changes were made and the number of oils were reduced about one-half.

In order to give the lubrication men complete information on where to lubricate, what lubricant to use, and the frequency of lubrication, we have made up lubrication charts for each type and make of machine in the plant. The "lubrication chart" is made up on $8\frac{1}{2} \times 11$ in. tracing cloth and two blueprints are made. Inasmuch as one chart may take care of a group of the same type of machines, our records are thus simplified. One blueprint copy is kept on file in the office and the other is placed in a transparent shop envelope. If the same type of machine is used in other departments, additional blueprints are made for their records. The transparent shop envelope containing the lubrication man's blueprint is kept in his cabinet, for ready reference. We had considered hanging a lubrication chart on each machine, but a trial showed they soon became soiled and lost. The lubrication man soon learns what oils are needed and does not often refer to the charts.

When the lubrication man takes care of a periodic reservoir oil change, he writes the date opposite the equipment number on his chart. He also reports the oil change to the office so that the office file can be kept up to date. The dates, when written in pencil, can be erased many times before a new blueprint is needed.

The information placed on the lubrication chart was obtained in most cases from the machine manufacturer through service manuals, machine instruction plates, and lubrication instructions which accompany most of the incoming new machines. In some cases letters were written to the manufacturers and they sent complete information. However, in order to standardize and simplify our line of lubricants, we did not adhere strictly to manufacturer's recommendations, but compromised on specifications such as viscosity, brand names, and grades of oil.

The following lubricants take care of practically all of our requirements:

Type of Lubricant	Saybolt Viscosity at 100 F.
Spindle Oil	125
Turbine Oil—Light	150
Machine Oil—Medium	180
Machine Oil—Heavy-Medium	280
Turbine Oil—Heavy-Medium	320
Machine Oil	1,000
Gear Oil—SAE 140	3,000
Grease—Plain Bearing	
Grease—Ball Bearing	

For ordinary lubricating throughout the plant we use a heavy-medium lubricating oil which has a Saybolt viscosity of 280 sec. at 100 F. This oil has an additive which gives it the ability to cling to metal and thus do a better job of lubricating than an ordinary machine oil. Our gear oil has a mild extreme-pressure additive which increases the film strength and preserves the life of the gear teeth.

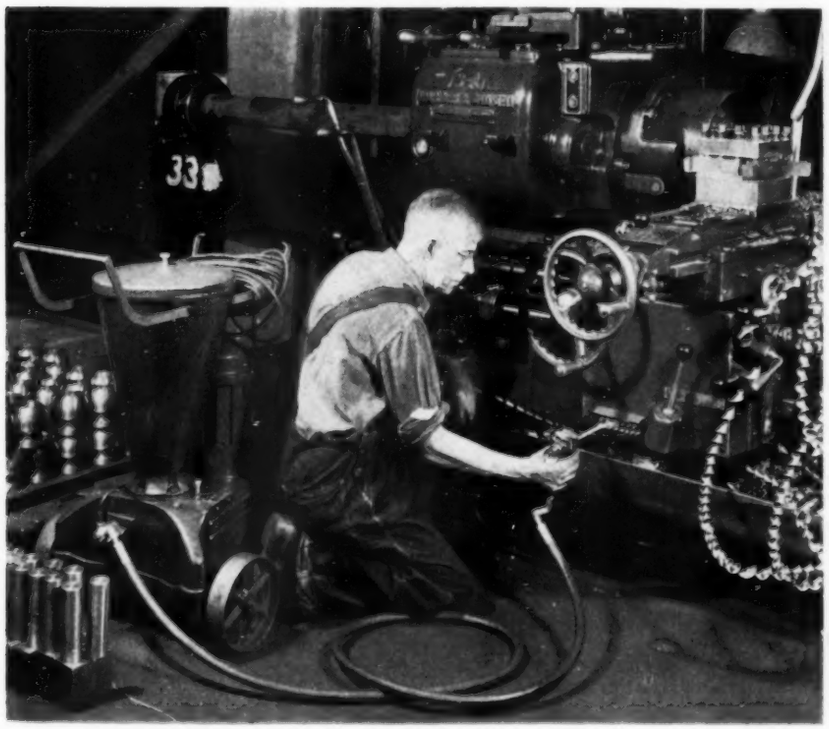
We use turbine oils in hydraulic reservoirs because it is a highly refined oil and the best oil is needed to perform the strenuous work that hydraulic oils must do. We demand an oil that will resist oxidation to the greatest degree. Highly oxidized oils form gums and sludges which interfere with the operation of the valves and pump mechanisms. Gums and sludges are especially harmful where vane or variable stroke piston pumps are used. Replacement parts and labor costs for repairs to hydraulic systems may be very expensive and our experience has shown that a high grade hydraulic oil is the least expensive over a period of time.

The oils and greases are stored in a building separated from our other buildings. A man is in charge of the oil storage and writes up a charge card for all oil ordered. This employee also delivers oil in barrels to various locations in the plant where the lubrication men have easy and quick access to them. Barrel pumps are used to pump the oil from the barrels to the lubricating men's containers. Not all oil is distributed in barrels. Oil which is not used in large quantities is stored in 5- or 12-gal. containers having either faucets or pumps. Although we use barrel pumps, faucets and barrel rocker stands, we find that barrel pumps require less room and eliminate the problem of leaky faucets.

Periodic oil changes are made in all reservoirs in periods varying from 6 to 12 months, depending on the way the oil stands up. We have checked the condition of the oil in different types of machine tools after various periods of use and have determined at about what interval it is best to change oil. Our machines have been in continuous 24 hour-a-day service during this emergency and as a result we play safe and change oil a little ahead of time rather than take a chance on the oil deteriorating with resulting machine breakdown.

When we send an oil sample out for test, we watch the following indications very carefully: (1) the acid condition of the oil as shown by the neutralization number, and (2) the ability of the oil to separate from water as shown by the steam emulsion rate.

As soon as the neutralization number reaches 1.0, the oil is replaced. The dangers of using oil with an acid condition are the corrosion of metals



Power grease guns are employed when lubricating machines equipped with high-pressure fittings. The lubrication chart for each machine specifies the frequency of lubrication

and the formation of unsafe sludges.

When the steam emulsion number reaches approximately 500 sec. the oil is replaced because the oil would emulsify readily if water were present. An emulsion promotes the collection of grit and foreign matter in the oil. When these particles are carried through bearings, they act as abrasives and cause excessive wear. If an emulsion breaks quickly, its harmful effects are reduced. A highly filtered and purified oil will separate quickly and, for this reason, should be used in circulating systems where the oil is repeatedly used over again. A new oil used in a machine tool reservoir circulating system should have a steam emulsion number below 60, and a neutralization number below 0.05.

The possibilities of savings by purchasing oil in larger quantities should be investigated. The largest saving is obtained by purchasing bulk oil in tank cars. Tank cars of 6,000, 8,000 and 10,000 gallons are available and savings up to 20 percent are possible in the cost of the oil. With tank car shipments it is, of course, necessary to have adequate tanks to handle the incoming oil. It is possible to get 6,000 gallon tank cars with three compartments holding 2,000 gallons each. These permit ordering smaller quantities of oil while taking advantage of tank car prices.

Savings up to 12 percent may be made by purchasing oil in freight car quantities of 65 barrels. Oil companies in many cases will permit ordering different types of oil in the 65 barrel shipment. It is also possible to purchase bulk oil in trucks, but due to shortage of these trucks it is difficult to get this type of service. Savings up to 6 percent may be made by purchasing oil in truck load quantities of 45 barrels.

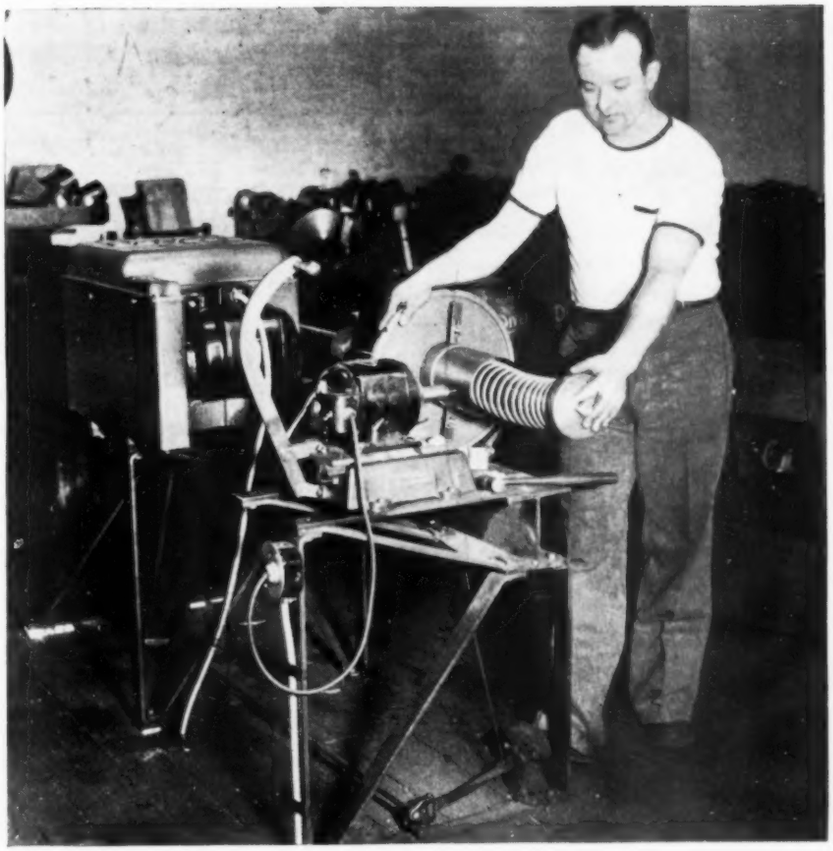
We keep records of our maintenance cost and have found that in spite of the additional strain on our machine tools due to 24 hour-per-day service our maintenance cost per machine has gone down since our introduction of the lubrication system. Comparing the first half of 1940, when we had no lubrication men, with the first half of 1941, our average maintenance cost per machine, including labor, repair parts, shop overhead and time, dropped about 6 percent. How much of this drop can be attributed to lubrication is difficult to determine, but the trend is in the right direction. These immediate results are gratifying, but we expect the efficient lubrication which our machines are now receiving will considerably extend their life and accuracy in the years of service which are ahead.

Barrels of oil are kept in a storage crib in each department. Pumps are used to transfer the oil to smaller containers

Individual oil storage tanks are kept filled by using this distributing tank mounted on a power truck. This man also has charge of the main oil storage room which serves the entire plant

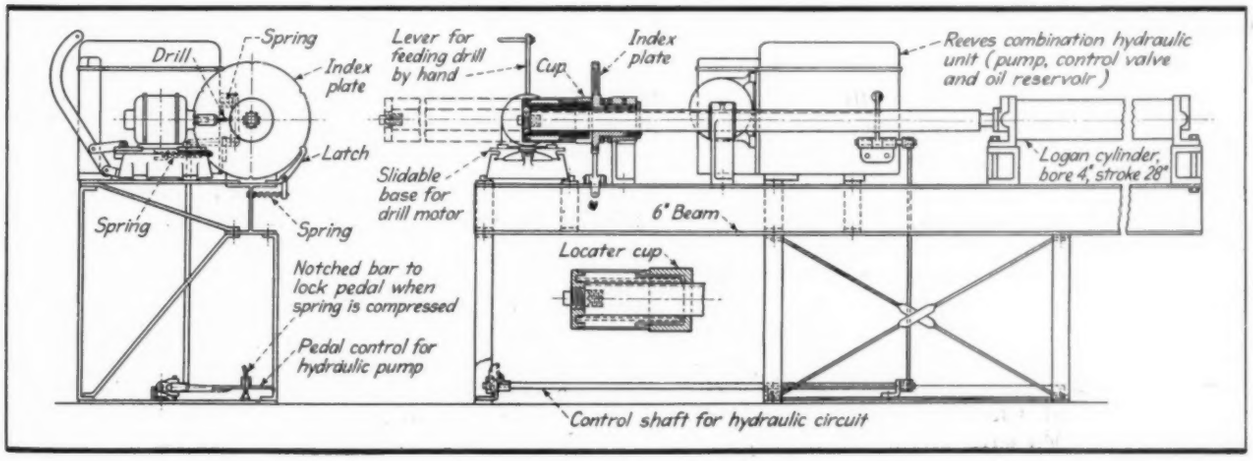
"Drill at Assembly"

One man can assemble 20 variable speed pulley units per hour with this special drilling machine assembled in the Reeves toolroom. Quite a machine for six 0.0820-in. holes in a relatively small assembly, but up to 250 lb. pressure must be exerted on spring before holes can be drilled



IN MANUFACTURING the three larger sizes of Reeves variable speed pulleys the spring must be assembled within the collapsible, protective cover under a pressure ranging from 150 to 250 lb., and six 0.0820-in. holes must be drilled around the circumference of the cover for escutcheon pins while the spring is compressed. Most of the special machine built for this job is assembled from standard units which were available in the shop. Hydraulic power is furnished by a Reeves combination hydraulic unit (drawn from stock, as it is one of the units developed for controlling certain variable speed drives).

When in operation, the long coil spring and its cover are assembled on the arbor, which is keyed to prevent rotation except when turned by the index plate, and the assembly is compressed until the outer cover unit contacts the locating cup and so aligns the head with the drill. This drill is carried in a chuck mounted on the shaft of a $\frac{1}{6}$-hp. motor, mounted on a slide at one end of the machine. Once he has assembled the necessary units on the arbor, all the operator has to do is to step on the control pedal which is connected to the hydraulic unit then, when the assembly has been compressed, advance the drill by hand for each hole, turning the index plate from one position to the next with his other hand. The drilled holes need be only $\frac{3}{8}$ in. deep, so the operation is rapid once the assembly has been compressed. Before the machine was available, this operation was difficult, since hand-operated clamps were used. The escutcheon pins which hold the assembly together are driven before the hydraulic pressure is released, so the assembly can be delivered directly to the painting group for finishing before transfer to finished stock.



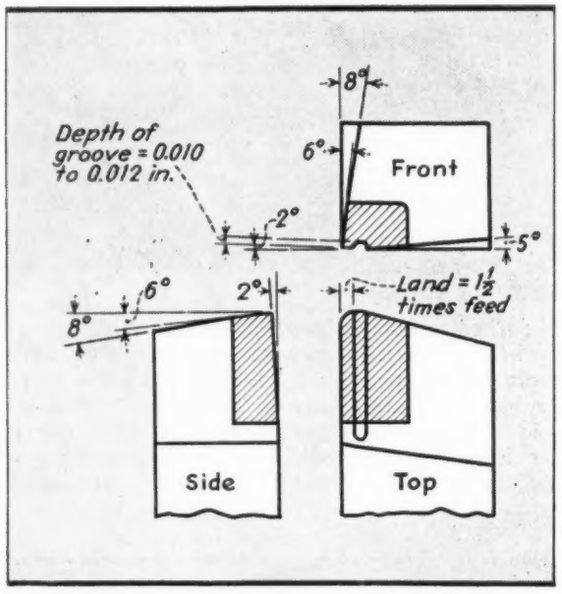
Built from standard elements, this drilling machine requires little effort on the part of the operator. Its use has made a difficult job easy and results in a better product

IDEAS FROM PRACTICAL MEN

Chip Breaker for Turret Lathe Tools

BY E. T. LARSON,
Norton Company

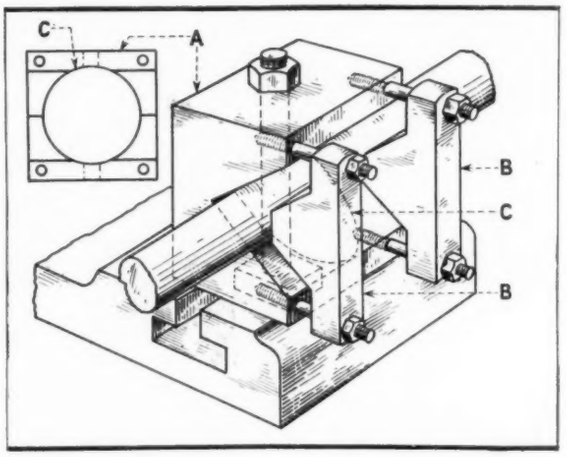
The chip-breaker groove ground in the illustrated cemented-carbide tool is being used by one manufacturer for high-speed turning in turret lathes. The chip-breaker groove is ground in the top surface of the carbide tip, parallel with the cutting edge, and separated from it by a land equal in width to one and one-half times the feed; for example, when the feed is 0.020 in., the land is 0.030 in. wide. It was found that when the land is less than one and one-half times the feed, the cutting edge will chip or flake. Should the width of the land be greater than



This chip-breaker groove was ground in cemented-carbide turret-lathe tools. The width of the land should be one and one-half times the feed

that recommended, the chip groove will be ineffective. The depth of the groove is usually held to between 0.010 and 0.012 in.

The groove in the tool was ground with a Diamond Metal bonded wheel 4 in. diameter and $\frac{1}{16}$ in. thick. Grinding was done wet with the tool supported in a universal vise to insure the same shape and dimensions of the groove each time. The vertical wheel feed did not exceed 0.0005 in. per pass. The wheel speed used was 4,000 surface ft. per min. This produced a groove close to the cutting edge without affecting the carbide tip in any way.



Three-point support is provided by this boring bar holder. It can be used for bars of different diameters and lengths

Tool Holder for Heavy-Duty Boring

BY E. W. HEINRICHS

The boring bar described by Arthur Havens (*AM*—Vol. 85, p. 593) is very rigid and suitable for turning duplicate parts, such as locomotive side rod bushings. However, all the boring bars have to be made to fit the holder, which may be objectionable in a job shop where various diameter boring bars are required for different jobs.

We have been using the illustrated boring bar holder in our shop because it will take bars of different diameters and lengths. The base *A* is bolted to the lathe carriage, and after the bar is inserted the caps *B* are bolted in place. The three-point clamping provided by this holder has in our experience been rigid enough for all classes of work. There is little danger of burring the boring bars with such a holder. The large hole *C* drilled through the body of the holder lightens the assembly considerably.

Soldering Copper Saves Metal on Long Seams

BY C. F. FITZ

We had a large quantity of long seams to solder on a special job. Considerable trouble was experienced in getting the solder at the desired place, in using a minimum amount of solder, and in keeping the joint free from solder smears.

We overcame these difficulties by drilling a $\frac{3}{32}$-in. hole in the end of the soldering copper, and a $\frac{5}{32}$-in. hole in one of the facets to meet the $\frac{3}{32}$-in. hole in

the end. We found that after heating the copper in the usual manner, and inserting wire solder in the hole on the facet, the hot copper melted the solder and it flowed out of the hole in the tip to the required place on the job. We thereby used a minimum of solder and obtained a good clean joint.

Cemented-Carbide Spot-Facer Made Quickly

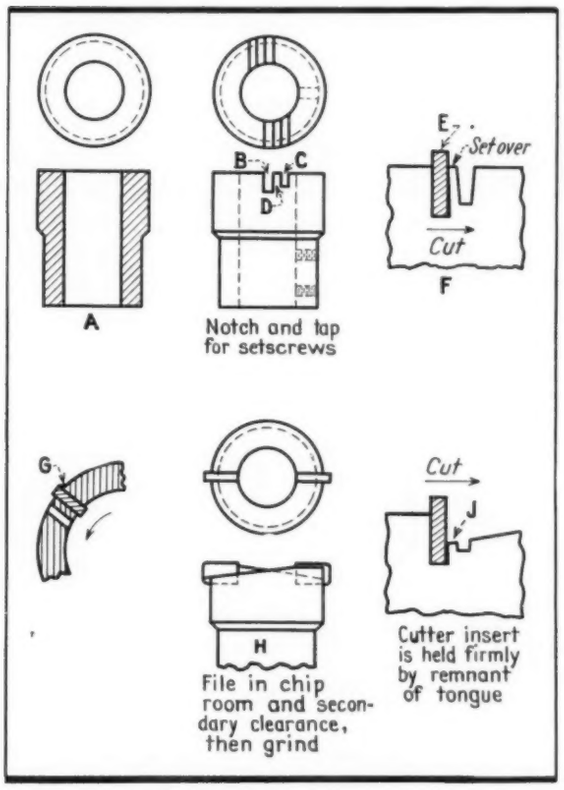
BY LAURENCE F. SOUTHWICK

We needed a spot-facer in a hurry and since the milling machine was busy, the illustrated design was made, mostly by hand. First, the blank *A* was turned. Then two notches *B* and *C* were cut with a hacksaw. Notch *B* was filed until the insert fitted easily. Then the tongue *D* was lightly driven over (with the insert removed) far enough to produce a drive fit for the insert *E*. The insert was positioned by inward pressure against the pilot (not shown) and downward pressure against the bottom of the slot as shown at *F*.

With the insert held firmly in place, it was brazed as shown at *G* to assure that it would not move during the spot-facing operation. This is of great importance because it obviates the difficult job of internal grinding usually necessary to make the cutter "hug" the pilot.

After brazing, the clearance was filed in as shown at *H*, using the safe edge toward the inserts and filing with an upward stroke. The insert remains supported over the entire back and by a ledge in front as shown at *J*. The tool was then face-ground, and the primary clearance (that of the inserted cutter itself) carefully ground in by hand with a fine wheel.

The method described is applicable to cutters having any number of teeth or of almost any shape. It conserves high-speed steel, and lasts indefinitely. The cutters which we have made in this manner are not heat-treated, giving an additional saving.

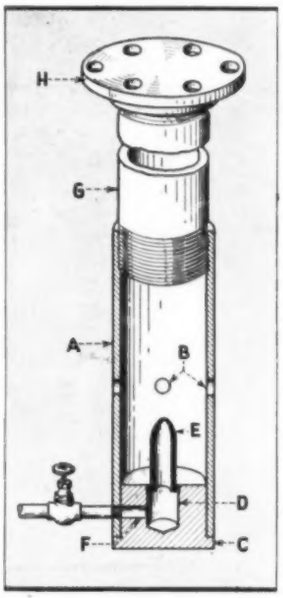


The insert in this shop-made spot-facer was placed in one of two notches and then brazed in place. The required clearances were then ground on the cutter blade

An Effective Siphon For Handling Dry Sand

BY W. E. ABBOTT

Two or more engine terminals may be supplied with dry sand from one drier if the labor costs and means of handling the dry sand warrants such an arrangement. The dry-sand siphon here described is used to load the sand into a box car, which is taken to another terminal and the sand removed from the car as needed. During the day shift at the drier, most of the sand needed for 24 hours is handled by one man who also loads the box car.



This dry-sand siphon, operated with air pressure at 100 lb. per sq. in., is used to elevate sand from the floor of the drying room into a box car along 30 ft. of pipe

Details of the siphon used at our enginehouse is as follows. A piece of tubing *A* 3½ in. outside diameter, 2½ in. inside diameter, and 9 in. long is tapped inside at the top end for a 2½-in. standard pipe thread. Four 2-in. holes *B* equally spaced around the tubing *A* are drilled 4½ in. from the top of the tubing. A plug *C* is pressed into the bottom of the tubing, and is 2½ in. in diameter, and 3 in. long, including the ⅜-in. head which is 3½ in. diameter. Hole *D* is drilled down through the center of this plug to a depth of 2 in. on top for a ¾-in. pipe thread. A 3¼x3½-in. nipple *E* is threaded at one end and closed at the other, leaving an inside diameter of ½ in. at the closed end to form a nozzle. Nipple *E* is then screwed into hole *D*.

The plug *C* with nozzle *E* is pressed into the tubing and a hole *F* is drilled through the wall of the tubing and into the plug to a total depth of 2⅝ in. so that it meets the hole *D* at right angles and leaves a clear passage. Hole *F* is drilled for a 1 in. standard pipe thread and is so tapped. The center of hole *F* is 1½ in. from the top of the plug. An air line is attached to hole *F*.

It is advisable to use a 4-ft. length of 2½-in. pipe *G* from the top end of the tubing to a flange *H*, because the sand cuts the pipe at about 2 ft. above

the tubing, and this section of pipe must be renewed at times.

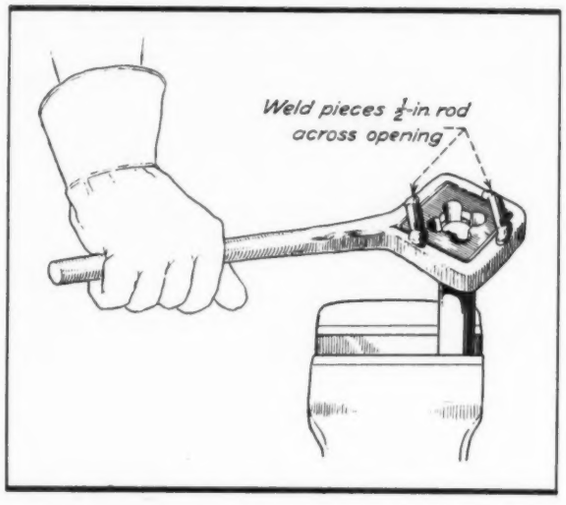
In operation, the siphon is immersed in sand, which is lifted through about 8 ft. of vertical pipe and along 15 to 20 ft. of horizontal pipe into the box car with an average pressure of about 100 lb. per sq. in. The box in which the siphon is placed is on the floor of the drier room with a screen top to sift from the sand anything that might clog the siphon.

Block Die Wrench Prevented From Slipping

BY ARTHUR HAVENS

The block die holder and guide described by Mr. W. E. Abbott (*AM*—Vol. 85, page 755) will, no doubt, prove very valuable when cutting threads; however, an elaborate guide of this type is unnecessary when chasing damaged threads. The ordinary die wrench is satisfactory even though it often slips from the die.

A simple and effective way of eliminating this difficulty is to weld two short pieces of $\frac{1}{4}$-in. welding rod across two of the corners of the wrench, as shown in the drawing. The welded piece permits the wrench to go on the die nut sufficiently for all purposes, yet they prevent it from slipping down too far.



When chasing threads with a block die, the box wrench can be prevented from slipping from the nut by welding $\frac{1}{4}$ in. pieces of welding rod across the corners of the wrench

Tool Depth for Threads Easily Calculated

BY EDWARD N. OLSON

In two of the three formulas published (*AM*—Vol. 85, pages 702 and 856) for obtaining angular travel of the tool when cutting a 30-deg. thread, the letter *N* was given as the pitch of the thread. Obviously, this letter indicates the number of threads per inch, rather than the given pitch of the thread.

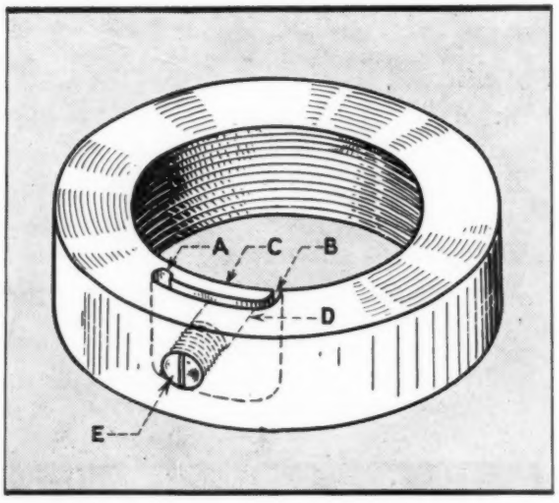
Even though the examples published in both articles use the number of threads per inch correctly, a student of mathematics might interpret the statement "*N* is the pitch" literally, and for nine threads per inch, use the fraction 1/9 instead of the diget nine. Should he do this, he would obtain in the formula 0.750/N the substitution 0.750/(1/9) or 0.750/0.111, giving 6.756 instead of 0.0833. This is exactly what happened when I gave the problem to two trainees in our shop. My point in mentioning this fact is that although an experienced machinist would not make such an error, an apprentice or trainee might do so, especially when so many of them are being trained quickly at the present time for machine shop work.

Positive Lock for Threaded Collars

BY L. KASPER

In cases where a threaded collar must be locked in position, it is common practice to provide a set screw which forces a copper pad or slug into the threads. This method is generally satisfactory, but at times proves troublesome as the copper pad may mushroom in the hole and does not free itself when the set screw is backed out. Again, there is always the possibility of the pad becoming lost when the collar is removed.

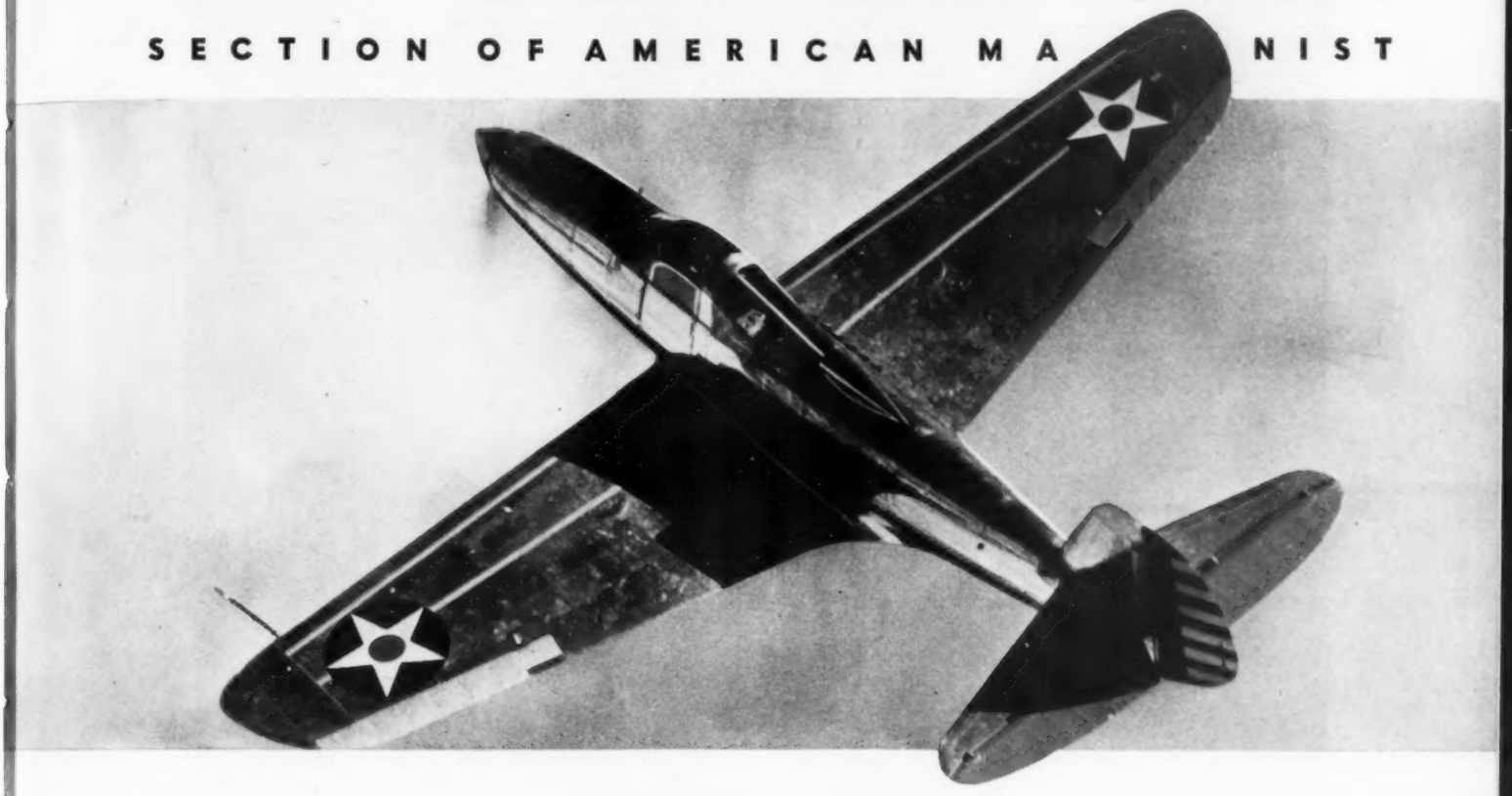
The illustration shows a method of locking a collar which is free of the above objections. A hole *A* is drilled axially through the collar and a saw cut *B* is made from the drilled hole into the threaded bore, producing a flexible tongue *C*. Hole *D* is then drilled and tapped, with a bottom tap, into the saw cut. When setscrew *E* is entered into the hole, the tongue is forced into the thread, providing a positive lock which will not mar the thread or the shaft, and will release its grip when the setscrew is backed out.



The slotted tongue of this collar will not mar the shaft when the setscrew is tightened, and will release itself when the setscrew is backed out

Armament

SECTION OF AMERICAN MACHINIST



HOW AIRACOBRAS ARE BUILT

BY O. L. WOODSON

Vice President and Assistant General Manager, Bell Aircraft Corporation

THE BELL AIRACOBRA is the world's only interceptor pursuit plane with the engine located near the center of the fuselage and behind the pilot. The nose of the ship is reserved for armament. This design was adopted to improve aerodynamic characteristics, vision, maneuverability and accessibility when making repairs, as well as to increase fire power. Aside from a complement of machine guns, there is a 37-mm. cannon that fires through the hollow propeller hub.

These planes, powered with Allison liquid-cooled engines, are listed in the "400-mile-an-hour" class. They are now rolling off assembly lines in the Buffalo and Niagara Falls plants at a rate seven times greater than that during the first half of 1940. This production is the result of (1) lofting each minute part of the plane, rather than major subassemblies only, (2) accurate tooling and (3) precisely scheduled subassembly and final assembly lines, the latter including two mechanically operated lines that simulate automobile production methods as shown in Fig. 1.

The Airacobra is comprised basically of five major subassemblies: (1) front fuselage, (2) rear monocoque fuselage, (3) wing panels, (4) fuselage carry-through member for the wings, and (5) the cabin. Large minor subassemblies include wing tips, superstructure, doors, and control surfaces. Each subassembly is designed as a complete unit for fabrication in assembly fixtures which enhance production by making possible total interchangeability of the subassemblies.

Because the engine is located near the center of the fuselage and behind the pilot, power is transmitted to the propeller through an extension-shaft

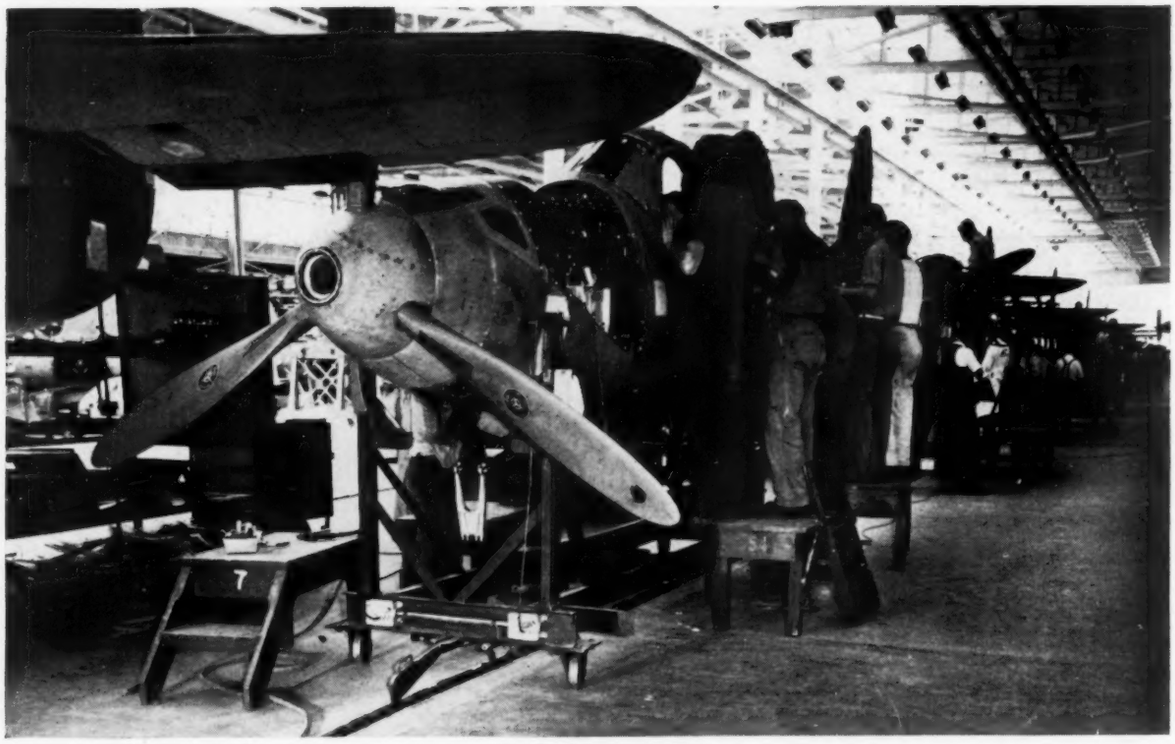


Fig. 1—To facilitate production, the Airacobra is broken down into five major subassemblies: the front fuselage, rear fuselage, wing panels, wing carry-through member, and cabin. The lofting of every minute part of the plane has resulted in decreasing assembly jigs by 30 percent. Automobile assembly-line methods are used

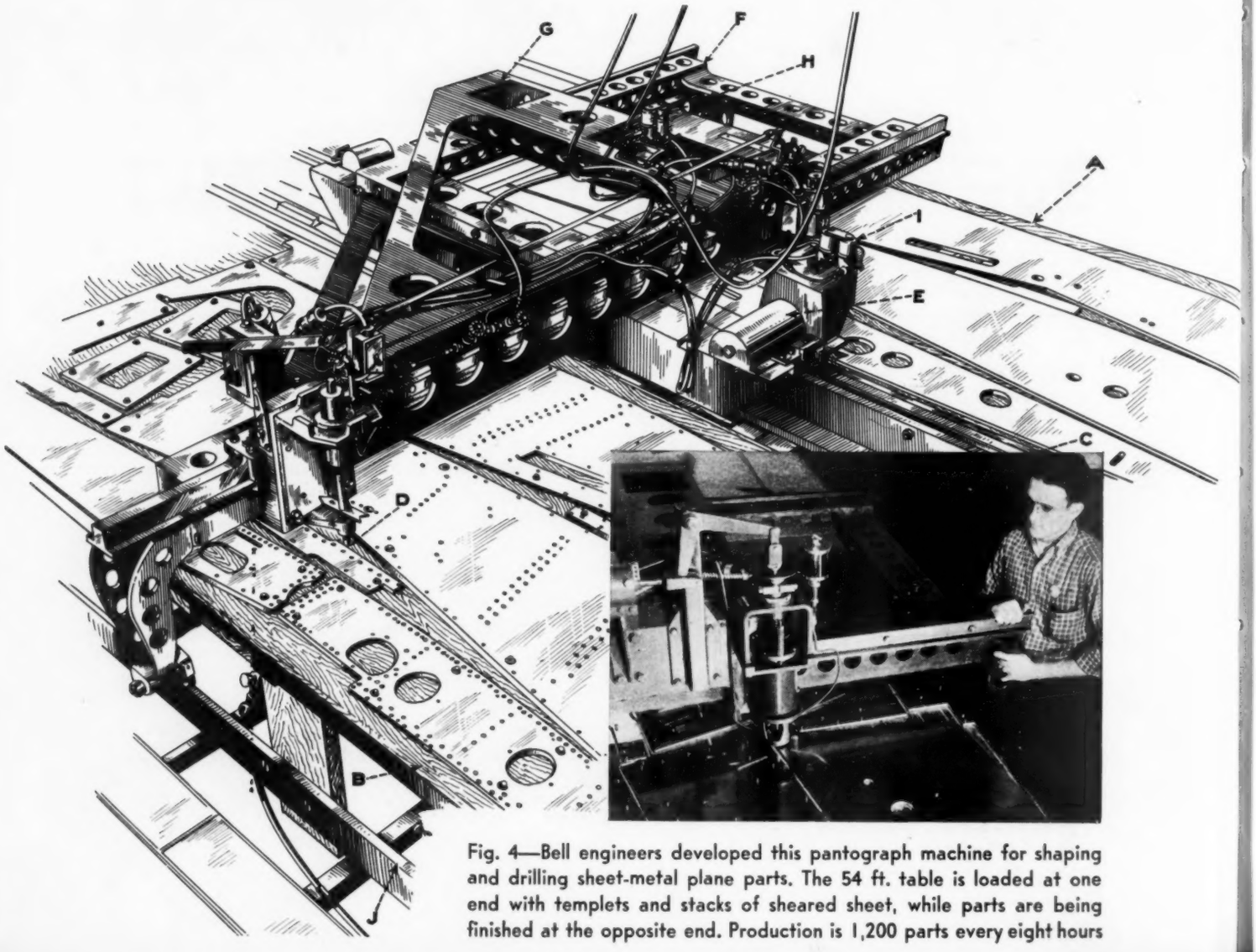


Fig. 4—Bell engineers developed this pantograph machine for shaping and drilling sheet-metal plane parts. The 54 ft. table is loaded at one end with templets and stacks of sheared sheet, while parts are being finished at the opposite end. Production is 1,200 parts every eight hours

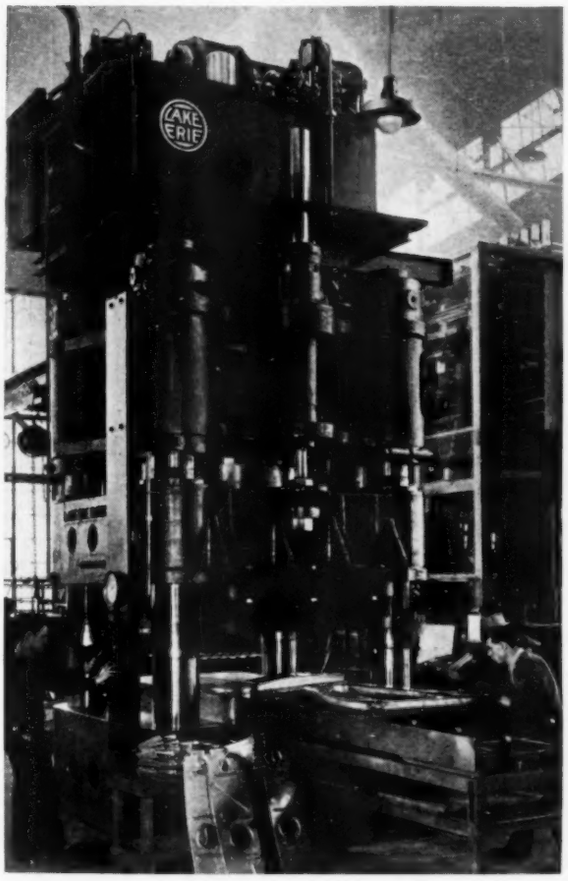


Fig. 2—Hydraulic presses form the majority of basic structural elements used in the Airacobra. Each press has two roller tables which are alternately loaded, pushed under the press ram, removed and unloaded to use the machine at maximum capacity

Fig. 3—Wing fillets, cowling and other large parts, which are either too difficult to form on mechanical and hydraulic presses or are made from heat-treated alloy, are produced on drop hammers. Dies are zinc and lead castings from plaster-of-paris patterns

assembly with a universal joint and a single intermediate bearing support. The shaft runs from the engine to an independent reduction-gear box attached to the front end of the fuselage and drives a hollow-hub propeller. The gear box also mounts the propeller governor and gun synchronizers.

Many of the basic structural elements of the plane are formed in hydraulic presses such as shown in Fig. 2. The parts include wing ribs, wing bulkheads, tail-surface ribs, fuselage bulkheads, door panels, instrument panels, floor members and control-surface parts. On each side of these presses is a flat plate resting on rollers which can be pushed onto the press platen when it is loaded with flat metal sheets from which parts are to be pressed. As many as four men unload and load each table on one side of the press while operators on the opposite side push their table under the ram. As soon as the parts are formed, the latter table is moved out for unloading and the loaded table inserted. This operation is continued in regular sequence and maintains production at peak load.

Drop hammers such as shown in Fig. 3 are used for forming wing fillets, cowling and other parts too large to handle on the hydraulic presses. In addition, parts which are difficult to make, either because they are too heavy or because they are made from heat-treated alloy sheet, are formed on the drop hammers. The punches and dies for the hammers are zinc and lead castings made from plaster-of-paris patterns.

Every single part of the Airacobra is first laid out to full size by the lofting department. Whereas the usual practice had been to loft only the larger parts of each unit, and then tool for the others, Bell now lofts each part individually, even machined parts and fittings. As a result, inexperienced shop workers can take two parts and match them perfectly, because not only has the outline of the design been matched, but all of the assembly holes are in correct position. Pilot holes are provided in bulkheads, stringers and

angles and other basic structural elements, which the workmen use for matching the completely drilled parts. The parts are then held together during production by clips inserted in these pilot holes.

Use of the 100 percent lofting system has eliminated about 30 percent of the jigs heretofore needed for production. Consequently, production has been speeded up, because the parts are more accessible to the workmen. Engineering drawings have also been eliminated from the plant, with templets only being needed. Here again, production is speeded up, because workmen don't have to read or study prints.

Because of its importance to the entire production method, the loft is the principal place where troubles are spotted. Any mistakes in design for any part, no matter how small, are discovered at once in the loft. Planning engineers study drawings released by the engineering department, and thus check that the parts, if properly made, definitely fit together to produce the desired dimensions and assure proper functioning. Also, troubles which may develop in the shop are quickly corrected through the lofting room.

All formed parts are made from flat shapes which are routed and drilled on a continuous pantograph machine developed by Bell engineers. The sheets are so routed and drilled that, after forming, all angles and holes are located precisely and ready for assembly into diverse structural elements of the planes. This is made possible by accurate lofting.

Pantograph Used for Routing

The pantograph machine, shown in Fig. 4, has two parallel tables *A* and *B* 54 ft. long with center rail *C* running between them, and is equipped with one router and two drills, one of the latter being located at each end of the table. The center rail *C* carries and keeps in alignment the templet stylus *D* and routing tool on the opposite end of the pantograph unit. The weight of the stylus and tools is carried on the center rail by steel rollers *E*. The motors are controlled by the operator until the stylus contacts the templet, after which the speed of cutting

Fig. 5—The structural core of the Airacobra is two of these longitudinal beams around which is built the front of the fuselage. Sections are held on a three-stand fixture for riveting and application of bulkheads

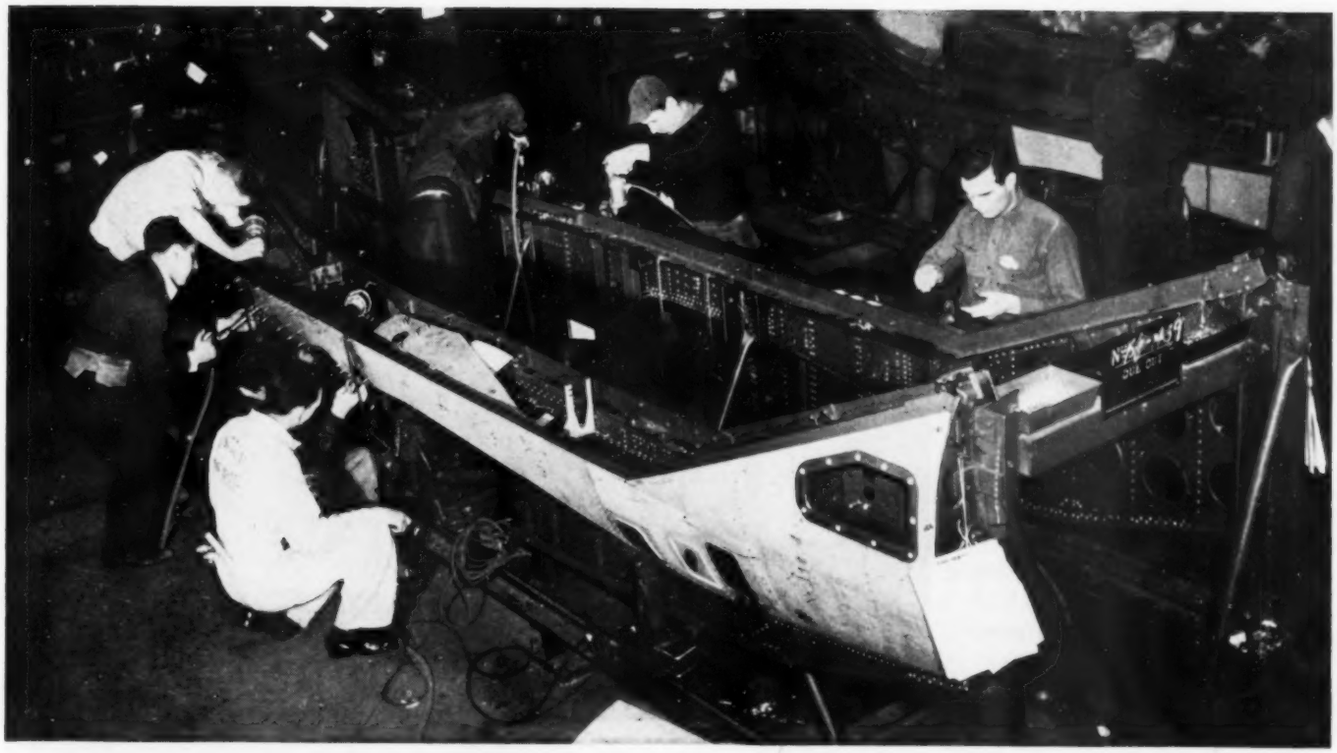
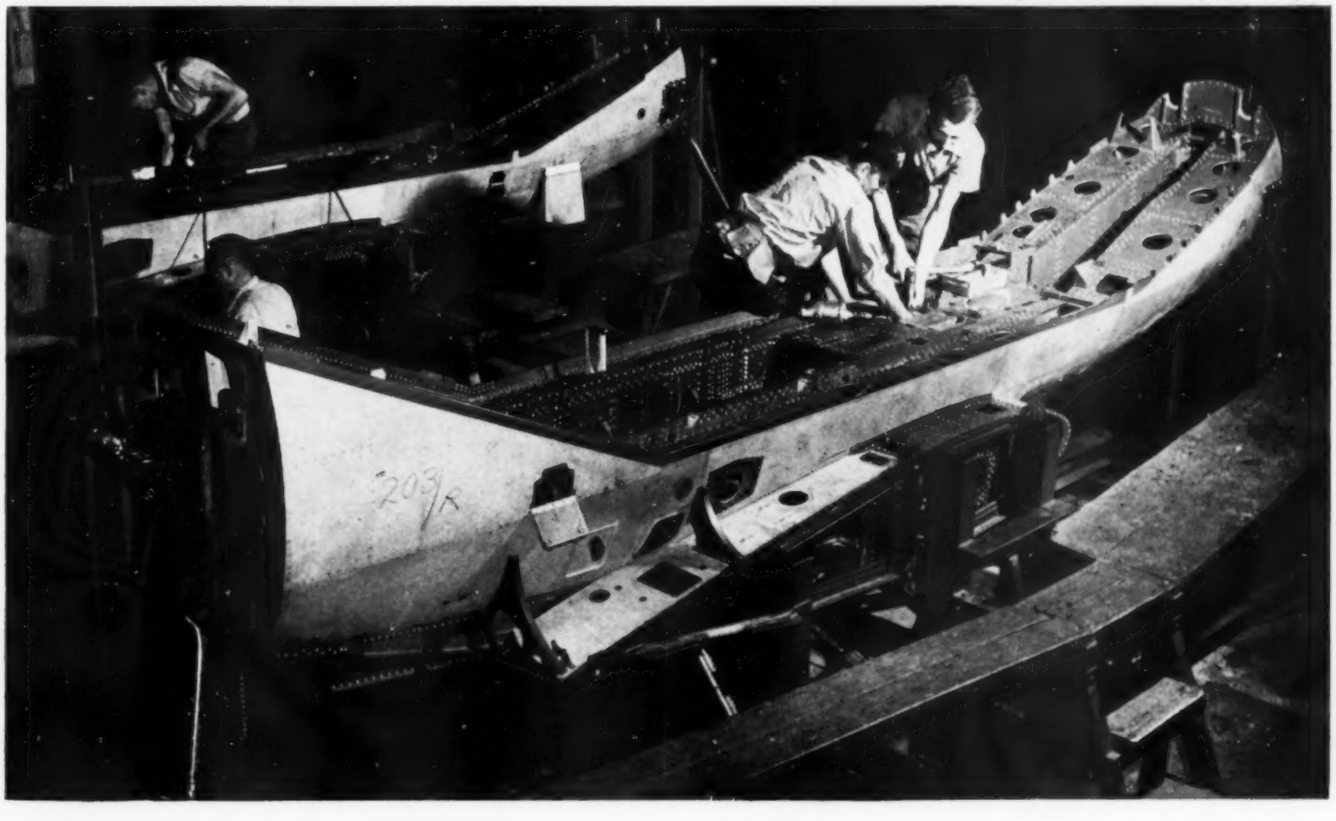


Fig. 6—Left- and right-hand longitudinal beams for each front fuselage section are mounted in this fixture and located by contour plates on the upright end members, as well as by angle irons on the intermediate vertical and horizontal members. Bulkhead assembly is completed here and stringers, web plates and skin are applied

Fig. 7—The carry-through members and longitudinal beams are spliced in this fixture. The former is located first by pinning it to the contour plate, after which the beams are set in place, pinned to the contour plate at the vertical end members of the fixture and bolted to the carry-through section. Spacer bars and web plates are riveted to hold the parts of the fuselage section in alignment



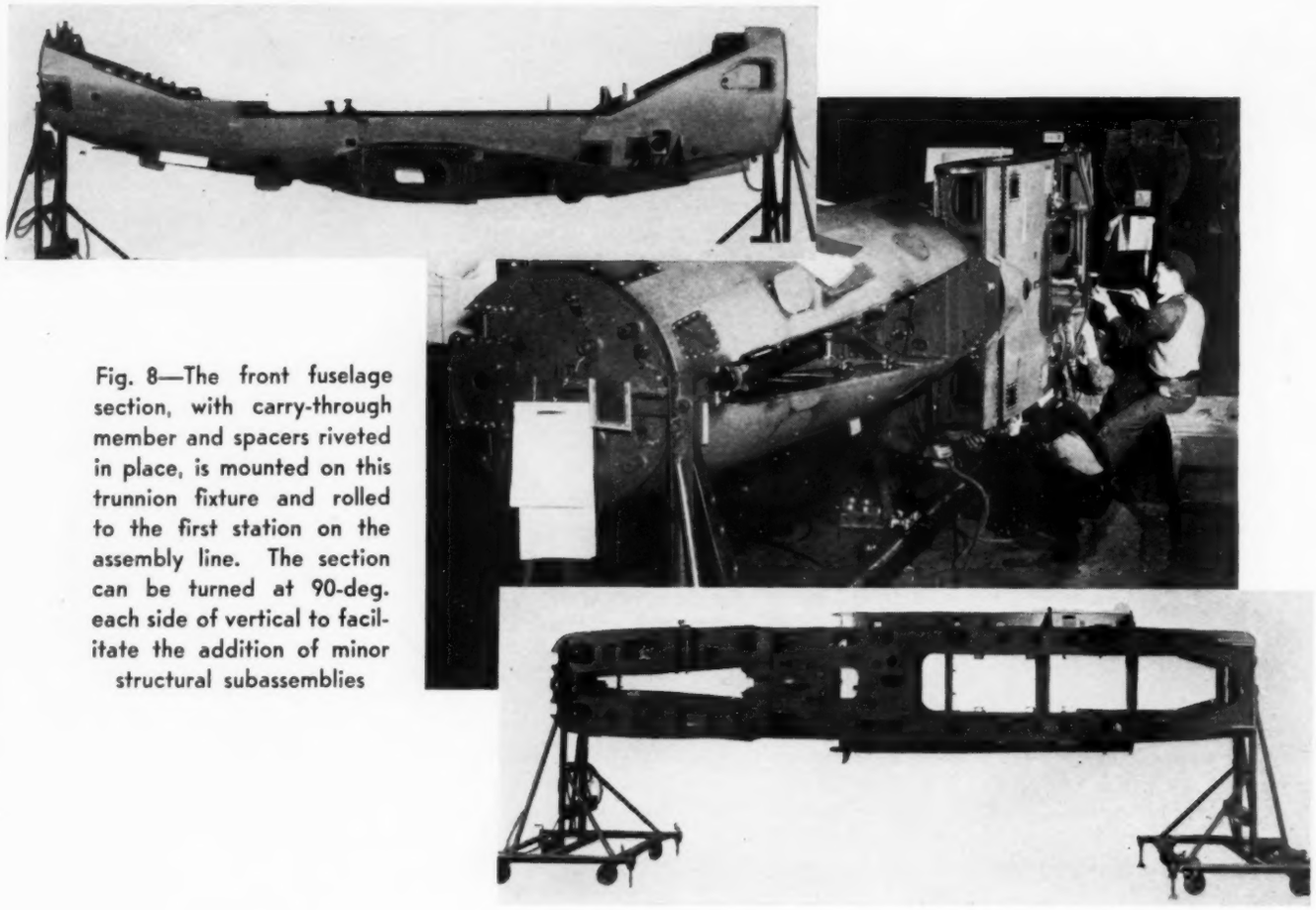


Fig. 8—The front fuselage section, with carry-through member and spacers riveted in place, is mounted on this trunnion fixture and rolled to the first station on the assembly line. The section can be turned at 90-deg. each side of vertical to facilitate the addition of minor structural subassemblies

Fig. 9—The front fuselage sections on the trunnion fixture are started down two parallel assembly lines at the Buffalo plant. It is here that plumbing, wiring, control brackets and armament foundations are applied

and direction of motion are controlled by pressure between the stylus and templet.

The pantograph unit consists of two super-imposed carriages *F* and *G*. Carriage *F* moves the length of the table on rail *C*, whereas carriage *G* moves cross-wise on rails on carriage *F*. The motion of carriage *G* is controlled by motors *H*, one of which controls left-hand movement, while the other controls right-hand movement. Longitudinal movement of table *G* is controlled by four motors *I*, two of which control left-hand forward movement, while the others control right-hand and reverse.

There are steadying rails *J* on the outside of the tables, with $\frac{1}{16}$ in. clearance between the rollers. These rails merely steady the unit laterally and prevent undue tipping.

The templets are fastened to 4x12-ft. plywood sheets and mounted on table *B*. The metal sheets are laid in stacks on table *A*, and after the first few holes are made they are mounted permanently with nails, after which all the remaining holes are drilled. The parts are then routed to shape.

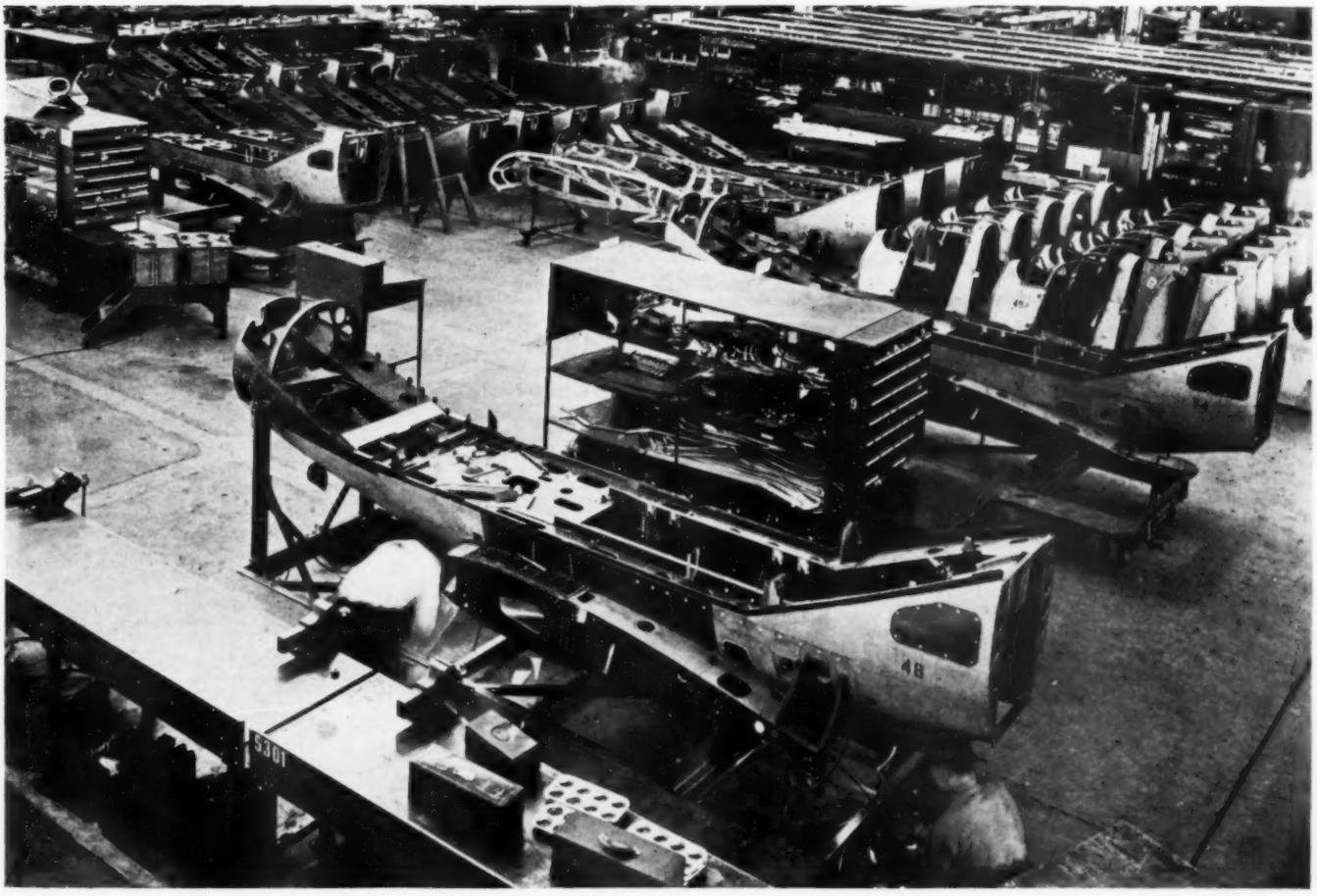
During the time that these sheets are being drilled and routed at one section of the 54-ft. table, templets and sheets are being installed at another section. One of the drills and the router are then moved to that location. As soon as the parts are completed, they are removed, a drill and the router are moved to another location on the table; thus, production on this machine continues without interruption.

Electric lines and air lines to this machine are carried on sliding overhead rails so that the leads hang perpendicularly from the unit as it moves back and forth along the transverse 54-ft. center rail.

This machine eliminates the necessity of fastening the templet to the alloy sheets, drilling the holes and using a vertical shaper or router to machine them to shape. This operation, permitting the dual production of routing and stack drilling, has increased production to the rate of a ton of parts every eight hours, or 1,200 pieces.

The structural core of the Airacobra, and the basic unit of the assembly, is two longitudinal main beams extending from the propeller back through the nose, under the cockpit, under the engine compartment, and connecting with the oval monocoque rear fuselage assembly which carries the tail surfaces. These beams are built up from angles and web plates in the

Fig. 10—Midway down the assembly line at the Buffalo plant, the front fuselages are cradled in dollies, wherein they remain during all final assembly operations. Cabin superstructure, wing fairing frames, and monocoque tail sections are applied first. Cabin subassemblies can be seen in the right background



assembly fixture shown in Fig. 5, which consists only of three tubular stands to which sections of the beam are clamped during drilling, riveting of sections, parts having been previously located by lofting.

Around these two beams is built the front fuselage section containing the central armament, ammunition installations, as well as the cockpit and engine platform. The two beams are placed in the fixture shown in Fig. 6 for the riveting of parts and attachment of skin. As shown, each fixture is designed to hold a right-hand and left-hand beam for one plane.

The carry-through member of the fuselage to which the wings are attached is a transverse beam. This structure is of steel, because of the heavy concentration of loads imposed upon it. The front and rear spars for this carry-through member are joined together with the ribs, the skeleton assembly being held at the four attaching points. Transverse and lateral bulkhead members are applied between the front and rear spars, and the skin is riveted in place.

The completed carry-through member is set in the fixture shown in Fig. 7, and the two longitudinal beams assembled in the fixture in Fig. 6 are placed over it. The two beams are supported not only by the carry-through member, but also by attaching plates that mate the ends of the beams. All landing gear fittings, gun-mount fittings and built-up spreader bars are installed. The latter, together with the carry-through member, keep the two longitudinal sections of the fuselage in alignment.

The assembled carry-through member and longitudinal beams, which form the basic structure for the front section of the fuselage, are mounted on the dolly shown in Fig. 8. The only attaching points for the assembly are two oval plates at the end of the dolly, the attachment being made by bolting to the end plates. The steel attaching plates are mounted on trunnions which permit rotating the assembly 90 deg. each side of vertical, for ease in the installation of parts on the assembly line. As soon as this fuselage section is placed in the dolly, it is rolled to the beginning of the assembly line shown in Fig. 9. After proceeding down the line for several stations, the assembly is removed from this dolly and set in the one shown in Fig. 10. Here the nose of the assembly is held by a horizontal bar inserted through the lift tube while the aft portion rests on the rear carry-through member supported by an I-beam. Assembly proceeds with the application of cockpit flooring, engine mounting rails, fairing fillets and cowling rings. The aft section of the fuselage is then applied.

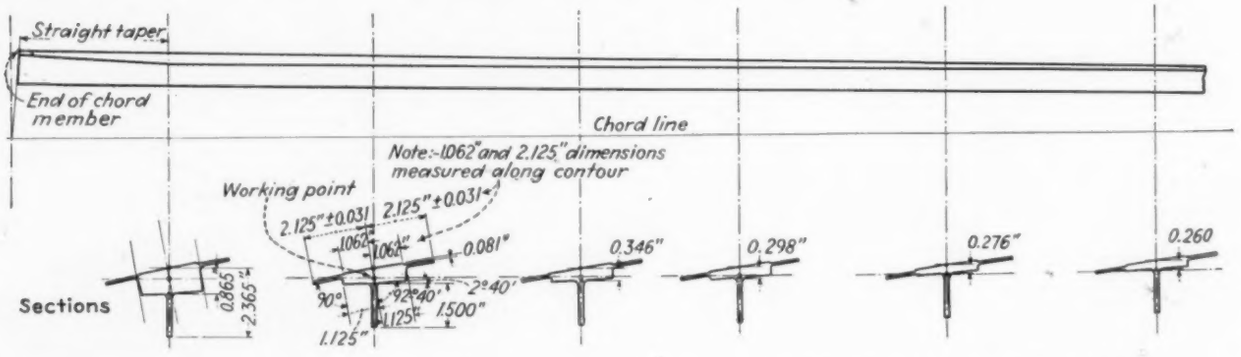
The tail portion of the fuselage is built in a fixture in which are placed elliptical bulkheads of gradually decreasing minor and major axes to correspond to the streamlining and diminishing taper of the tail of the plane. The bulkheads are pre-assembled in fixtures. The largest and smallest bulkhead are attached to contour rings, while two additional bulkheads are attached at the stabilizer fittings. The last attaching point is at the rudder bracket. Remaining assembly proceeds with the application of stringers, additional bulkheads and the skin.

Capstrips Milled in Twelve Minutes

The cantilever wings of the Airacobra are of stressed skin multiple-spar construction. Each wing is comprised of a front spar and nose assembly, a rear spar connected to the leading edge assembly with transverse ribs, and a trailing edge with an auxiliary spar connected to the rear spar with additional transverse ribs. The internal ribs and bulkheads are stamped or pressed metal. Fuel tanks are built integrally into the wings.

The capstrips for the spars are delivered to the Bell plant as rough extruded duralumin shapes and

Fig. 11—The wing spars are built around duralumin capstrips which have straight webs. However, the contour and thickness of the flanges change throughout the length to suit the shape of the wing surface and loads imposed upon it. These capstrips are milled to complete shape in two passes through a special milling machine. Each cut on a 13-ft. beam requires but twelve minutes



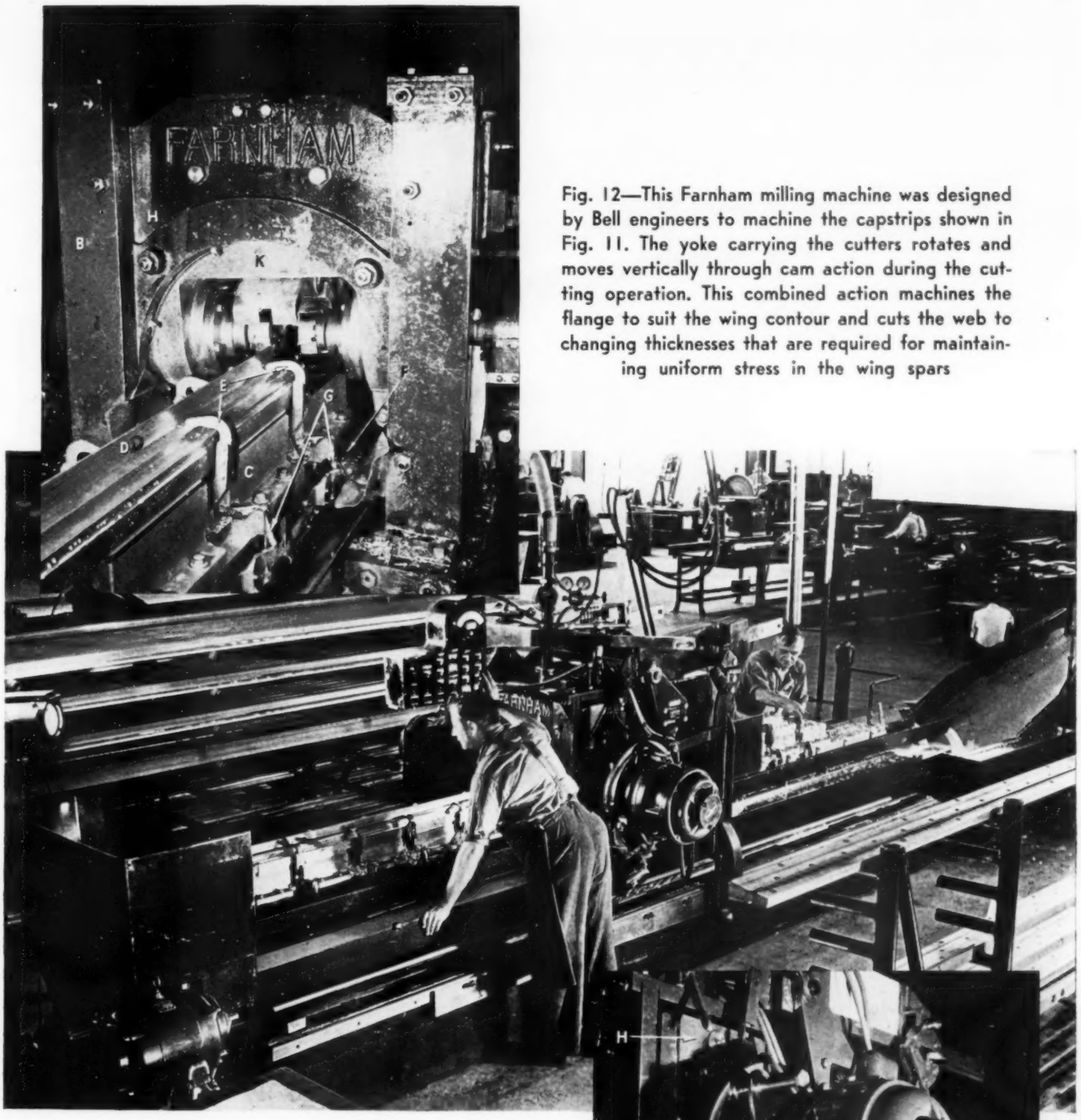
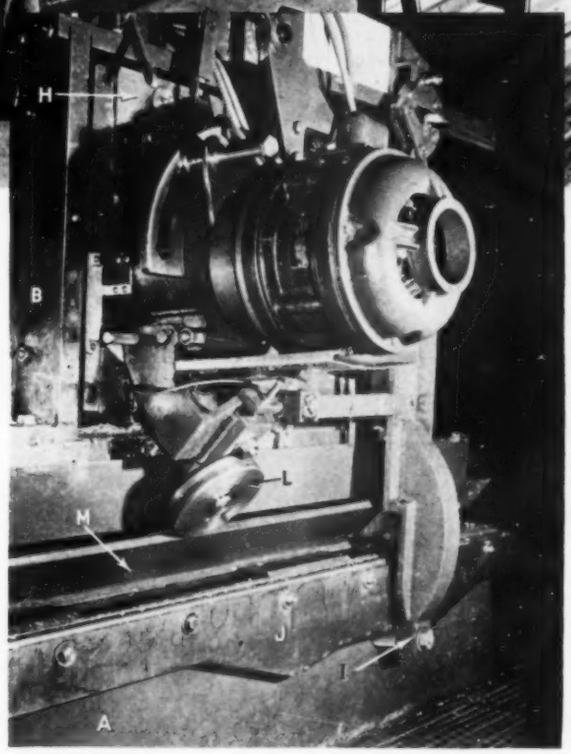
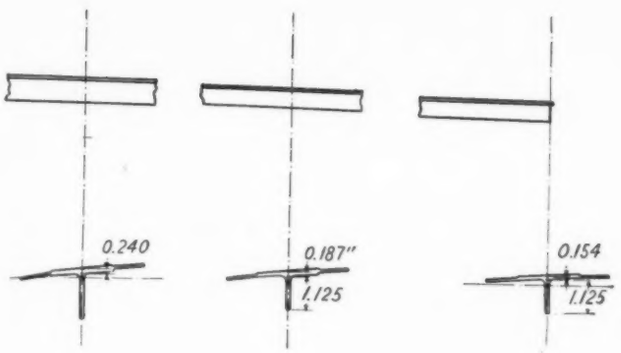


Fig. 12—This Farnham milling machine was designed by Bell engineers to machine the capstrips shown in Fig. 11. The yoke carrying the cutters rotates and moves vertically through cam action during the cutting operation. This combined action machines the flange to suit the wing contour and cuts the web to changing thicknesses that are required for maintaining uniform stress in the wing spars





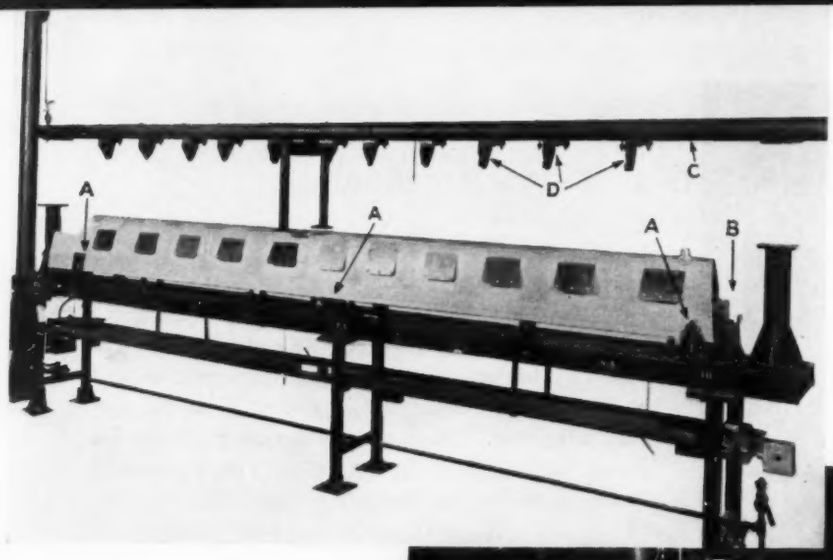


Fig. 13—Spars are held and aligned by contour brackets in this fixture, after which ribs and skin are added to form the leading edge of the wing. The ribs are aligned by the top cross-member, which can be raised after the ribs are riveted to permit attachment of the skin

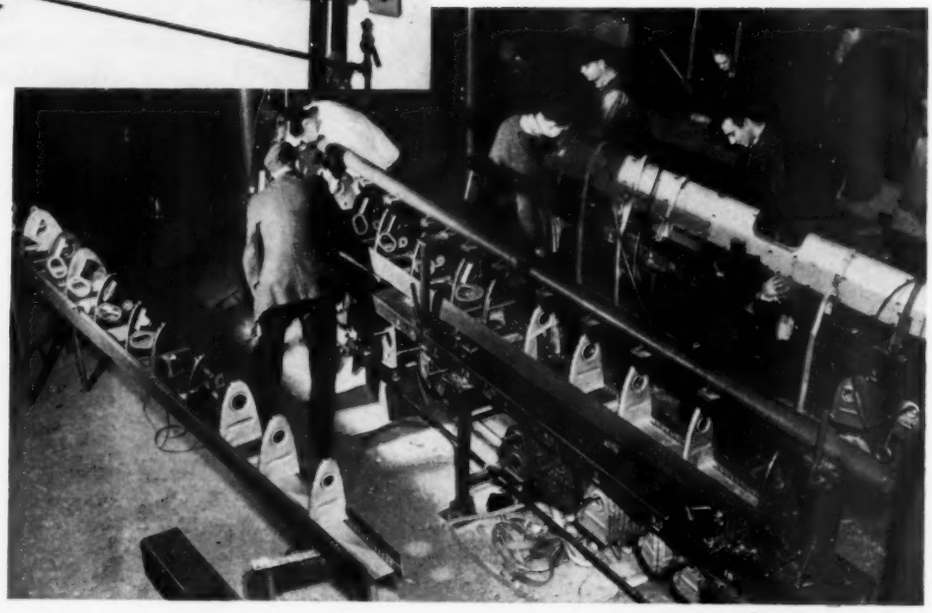
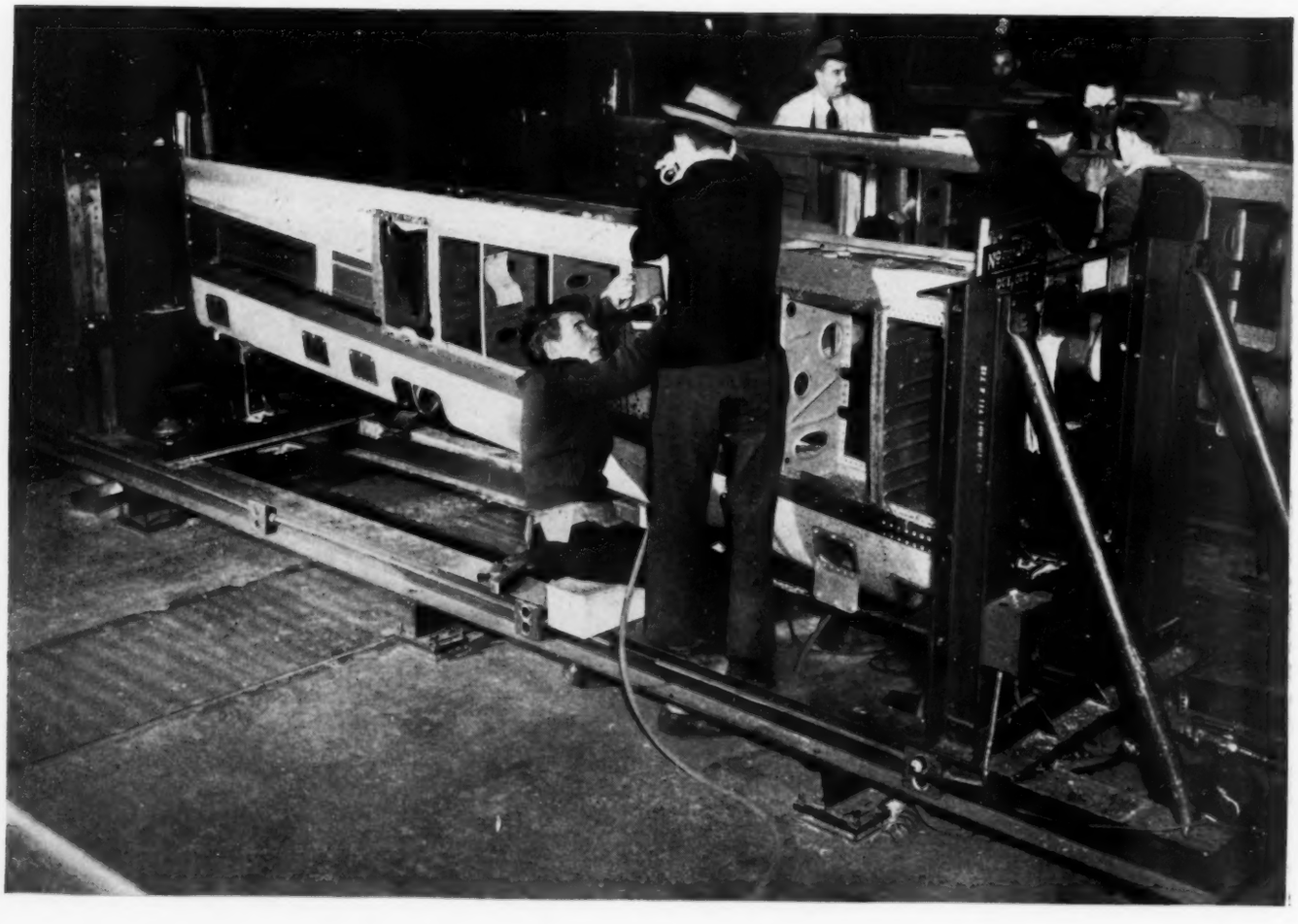


Fig. 14—The rear spar and leading edge of the wing panel are held by contour plates at each end of this fixture. Intermediate bulkheads are clecoed and riveted to form the beam-to-beam section. Coordinating holes are predrilled in these parts with which to fasten the skin. Final drilling and riveting follow



are machined with straight webs and contoured flanges to suit the lines of the wing. The outside of the flanges are machined with offsets so that the skin when riveted in place forms a flush surface for the air foil. The spars shown in Fig. 11 are 13 ft. long and are finish machined on a Farnham milling machine that was designed to Bell specifications especially for this job.

This machine, shown in Fig. 12, consists essentially of a stationary base *A*, and tool carriage *B*. The latter, mounting the driving motors, spindles and cutters, slides on base *A* and bridges the fixture *C* which holes the spar capstrip *D*. The fixture *C* is of cast duralumin and was machined to shape in the machine itself.

Mounted on the base of the machine and housed in the fixture *C* are 32 air clamps *E*. These are operated by air pressure, and hold the capstrip in position on fixture *C*. Cam *F*, attached to the moving carriage, operates the air clamps by hitting and depressing clamp fingers *G*, so as to take clamps *E* out of the way as they approach the cutters and return them after they have passed the cutters. These clamps can be operated by a single lever at each end of the machine when loading or unloading the work. In operation, the clamps rise vertically, then swing in and out of position.

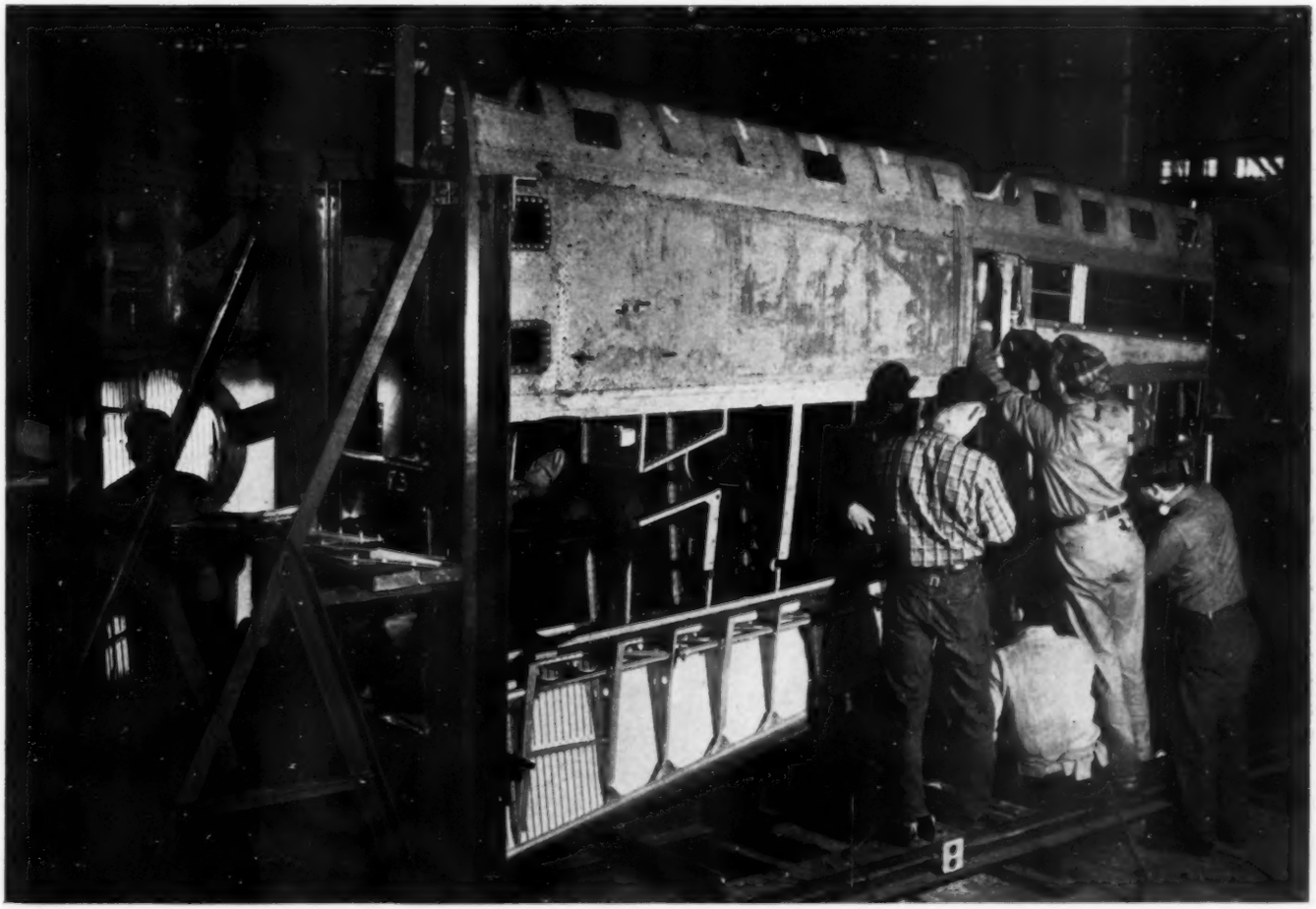
On the bridge of the machine is crosshead *H* which carries the motors, spindles and cutters: it can be adjusted vertically but not longitudinally. This vertical movement is controlled by roller *I* and templet *J* as the bridge traverses the table. The vertical adjustment is necessary to control the thickness of the capstrip flange for uniform loading of the beam along the length of the wing.

Yoke *K* rotates in crosshead *H*; this action takes place as roller *L* moves along templet *M*; in the case shown, the templet *M* is straight to produce a straight capstrip. Rotation movement of yoke *K*, carrying with it the cutters, is accomplished by means of a templet which provides the twisting motion necessary to produce the contour on the outside of the capstrip to correspond with the air foil of the wing.

Chips are produced at the rate of one barrel every 6 min.; consequently, it is necessary to have a strong force of soluble oil to carry the chips to the rear of the machine. There the chips are picked up by a conveyor and deposited in barrels.

The cutters travel at a surface speed of 4,200 ft.

Fig. 15—The beam-to-beam section is placed in this fixture. An auxiliary spar, forming the trailing edge, is added, and intermediate bulkheads are applied. The entire wing is completed in this all-unit assembly fixture



per min. The heat is generated in the chips, which are disposed of before the heat can enter the cutters. The cutters are of medium-carbon low-tungsten steel with 20 deg. clearance angle on each tooth. They are highly polished all over to prevent adherence of the duralumin chips at the high cutting speeds used. The large clearance angle, polished cutter surfaces, and high centrifugal speed all contribute to the discharge of the chips from the cutters, thereby preventing a built-up edge on the cutting teeth, scored work, and short cutter life.

Experiments have been conducted with straight carbon steel cutters and have proved to be entirely satisfactory because of the high polish which can be given them. Other experiments with cutters of 0.75 carbon and 3.00 tungsten have been made at surface speeds up to 12,000 ft. per min. with 8-in. cutters without coolant. The temperature increase of the cutters seldom exceeded 30 deg., although the chips were hot, but not enough to show discoloring.

Not only are the capstrips for wing spar made on this machine, but also those for carry-through members used in the fuselage.

The actual milling time on one of these capstrips, all of which are 13 ft. long, is 12 min. for each of two cuts. Prior to the development of this machine, subcontracting prices ranged from $170 for a 7-ft. contour-shaped capstrip to $125 for one 11 ft. long with no contour; that is, one with a straight flange and web for the carry-through member. Now the cost has been cut to about eight dollars.

Assembly Fixtures

The spars are assembled in a fixture in which the capstrips are set between brackets the shape of which mates the gradually changing contour of capstrips. Web plates routed to shape and completely predrilled by lofting are inserted, clamped with hinged arms that can be pinned in only one position. Adjustable screws with beveled heels hold the web plates in position on the capstrips during transfer of the holes from the webs to the capstrip and the driving of preliminary assembly rivets. Final riveting is done in a press capable of driving several rivets at one time.

Subassembly of the leading edge is shown in Fig. 13. The spar is placed on the base of the fixture in locating brackets *A* beveled to the contour of the capstrip, thus preventing the spar from moving laterally in this fixture. Straight locating brackets *B* at the end of the fixture prevent the spar from moving longitudinally. The top number *C* of this fixture can be raised and lowered and has locating points *D* for nose ribs. These ribs are placed on the spar, clecoed in place with the top horizontal bar down, and then the ribs are riveted in place. The skin, predrilled and formed in the hydraulic press, is placed over the ribs, each of which has two predrilled coordinating holes. The remaining holes in the ribs are then drilled through the predrilled holes in the skin. The skin is clecoed and the assembly riveted through the access doors.

The leading edge when assembled goes to the beam-to-beam fixture shown in Fig. 14. Contour plates at each end of this fixture contain the only fastening points for the leading edge and the rear spar. Intermediate bulkheads separating the two spars are inserted, placed in position by means of coordinating holes, clecoed and riveted. Coordinating hole are predrilled in these parts for preliminary fastening of the skin, which is completely predrilled. Following application of the skin, the assembly is drilled and riveted. Two-thirds of the wing area is completed in this beam-to-beam fixture.

The rear spar is actually at the center of the outer

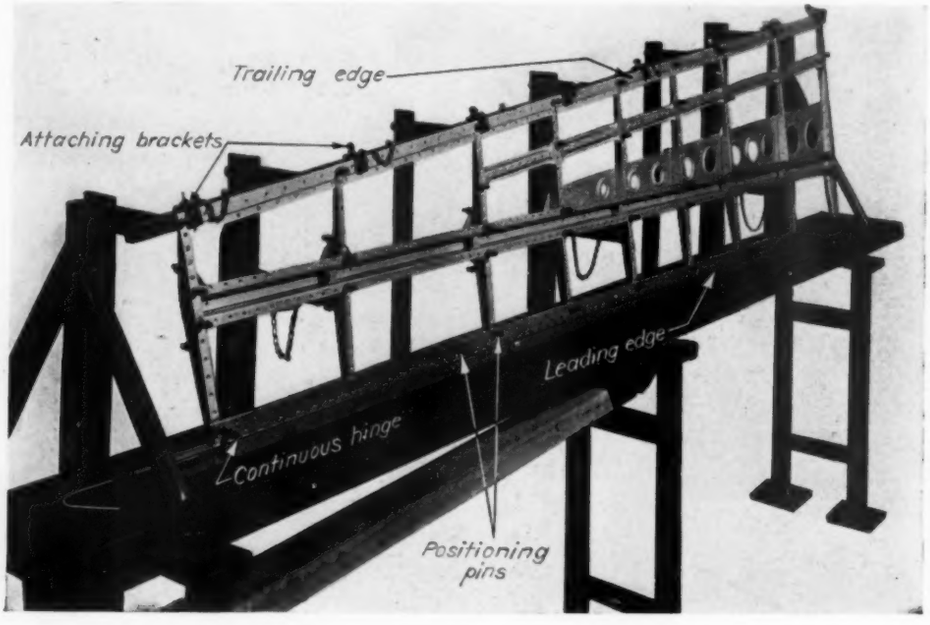


Fig. 16—The ribs for this trailing edge wing flap are made on the hydraulic press, while the angles and continuous hinges are made on the draw bench. These parts are assembled in this fixture, after which the skin is applied

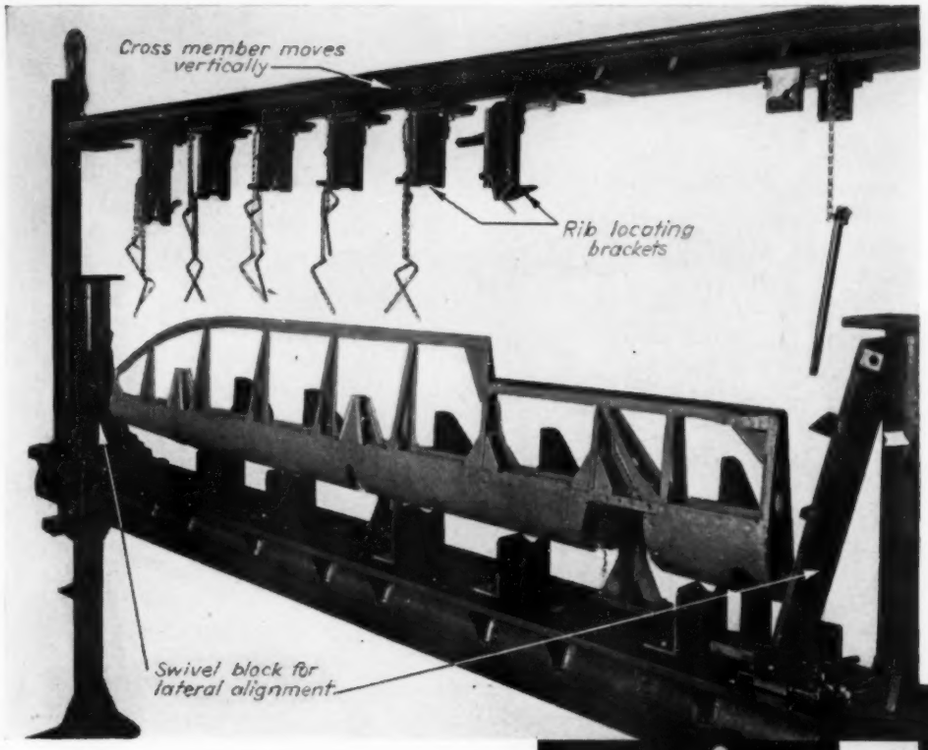


Fig. 17—The metal skeleton of each aileron is assembled in this fixture. The leading edge is pre-assembled. The ribs and trailing edge are clecoed in place after being aligned by the horizontal cross-member. When the ribs and trailing edge are riveted, the cross-member is raised to the position shown here for removal of the assembly

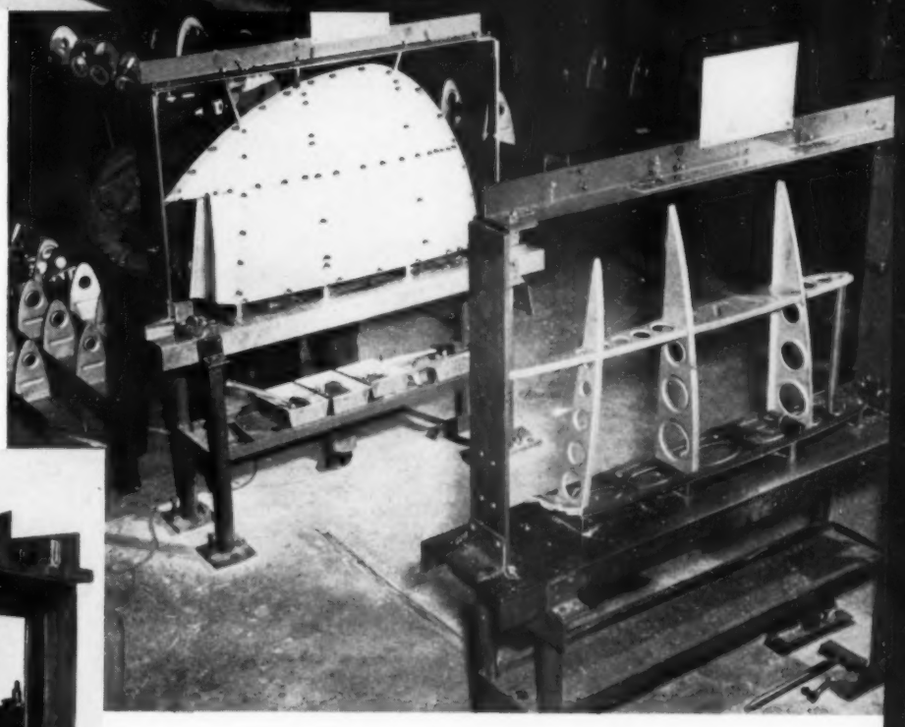


Fig. 18—Three struts and two ribs are assembled in this fixture to form the wing tip. After the press-formed members are riveted, the skin is clecoed. The wing tip is laid on a work bench for riveting through access holes at the wing-panel attaching rib

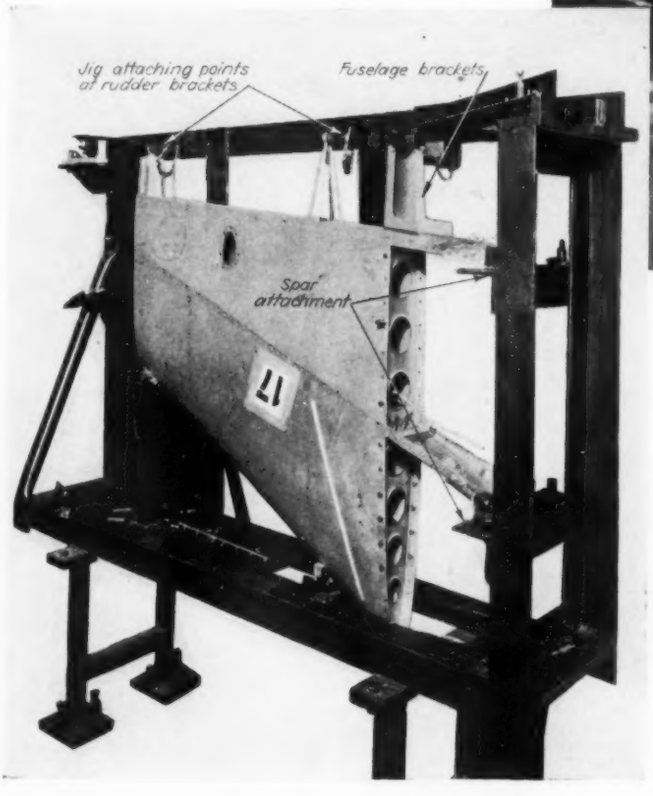


Fig. 19—The spars for the fin are pre-assembled and located by attaching points in this fixture. Rudder and fuselage brackets are also attached to the fixture frame. Intermediate ribs and the skin are then added to complete the assembly

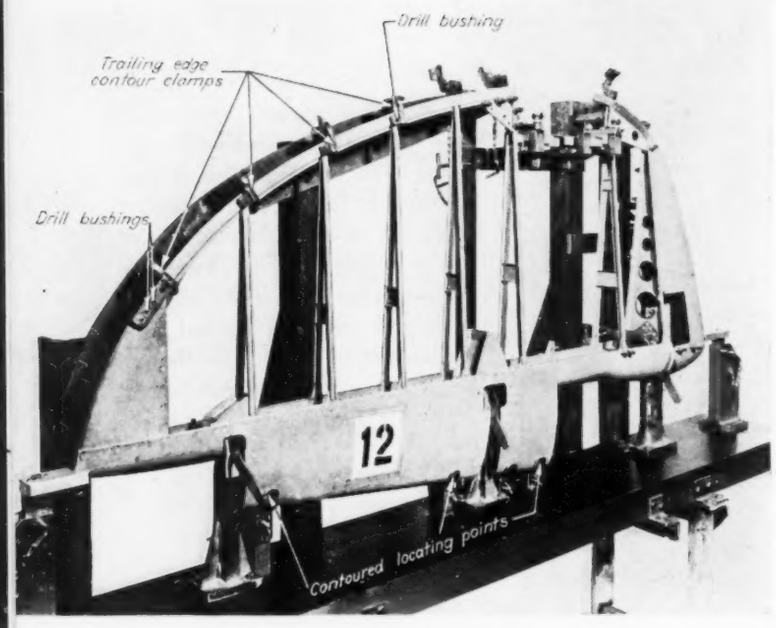


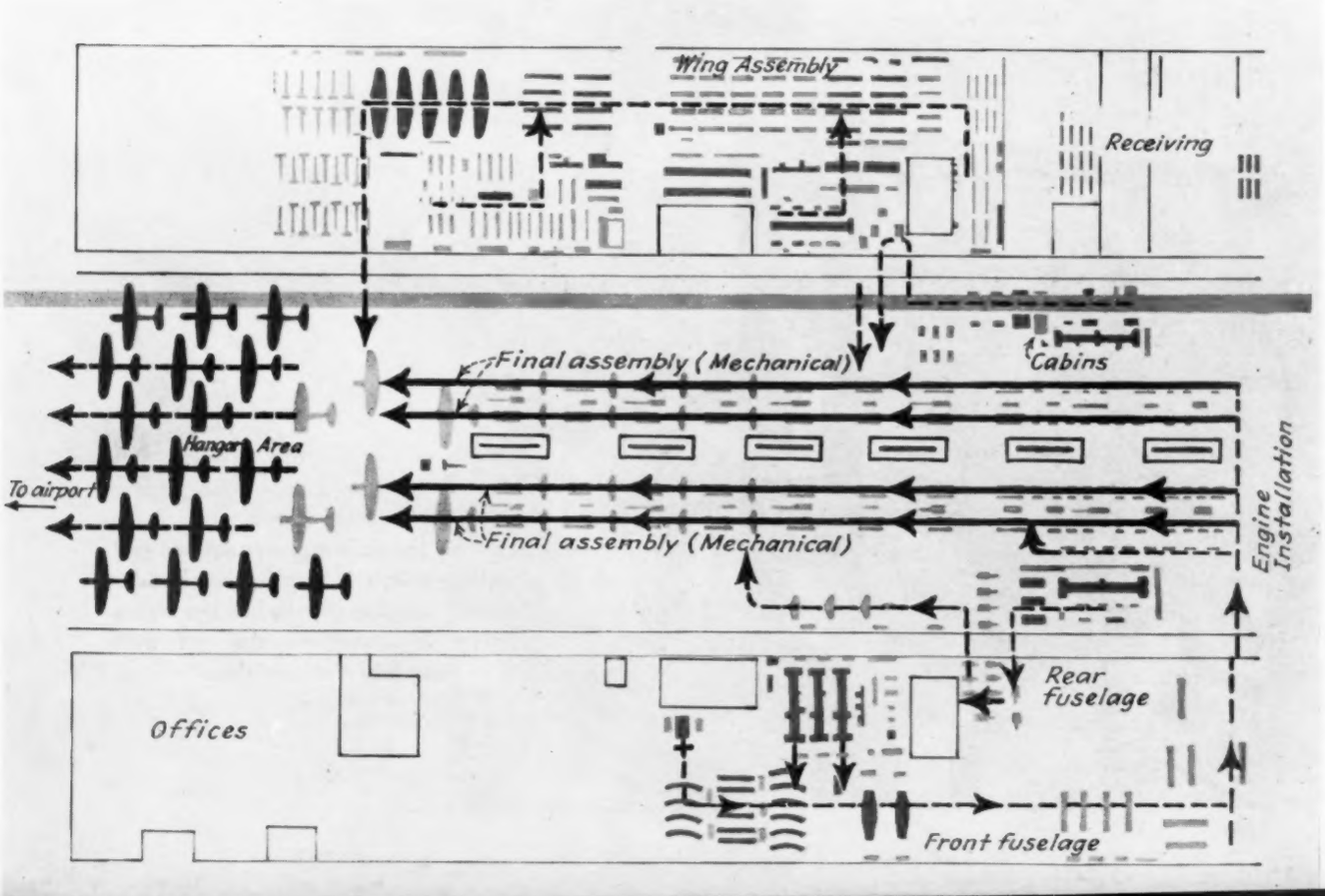
Fig. 20—The pre-assembled leading edge of the rudder is set in the contoured locating brackets of this fixture prior to assembly of the ribs. The trailing edge is held to the ribs with swivel clamps equipped with guide bushings for drilling the trailing edge

wing panel, as can be seen in Fig. 15, where the beam-to-beam assembly is fastened in a fixture with attaching points on contour plates at each end of the structure. The auxiliary beam, forming the trailing edge to which the flap and aileron are attached, is also fastened to the contour plates, after which intermediate bulkhead and rib sections are inserted between the rear spar and auxiliary beam. The wing, except for the application of the flap and aileron, is completed in this all-unit assembly fixture.

It may be well to note at this point that, because of its system of 100 percent lofting, Bell Aircraft is able to use relatively simple assembly fixtures, which serve merely to hold the component parts of the structure in correct position during assembly, including the preliminary riveting. This method is opposed to that which is used elsewhere which requires complicated and expensive jigs, in which rivet holes are spotted and drilled, in addition to the actual assembly operations.

Split trailing edge wing flaps are provided on each outer wing panel, extending from the inboard end of the ailerons to the fuselage. A feature of the flap design is the proportioning of the span, chord and angular deflection of the flaps so that the effective downwash angle of air flow on the tail surfaces is increased to a degree where the change in trim of the airplane is negligible from stabilized level flight at cruising speed with the flaps up, to a stabilized glide with power off, providing coordinated trimming action for the landing approach. The fixture in

Fig. 21—There are four assembly lines at Bell's Niagara Falls plant. These move mechanically a fraction of an inch each minute. The subassembly departments are so located that their own production lines feed into the correct station along the final assembly



which the flaps are assembled is shown in Fig. 16. The ribs are formed on hydraulic presses. The continuous hinge manufactured by Bell Aircraft is for attaching the flap to the trailing edge of the wing. The main beam shown at the center is formed on a draw bench, as is the trailing edge. The beam and trailing edge are clecoed together, and the skin is applied and riveted.

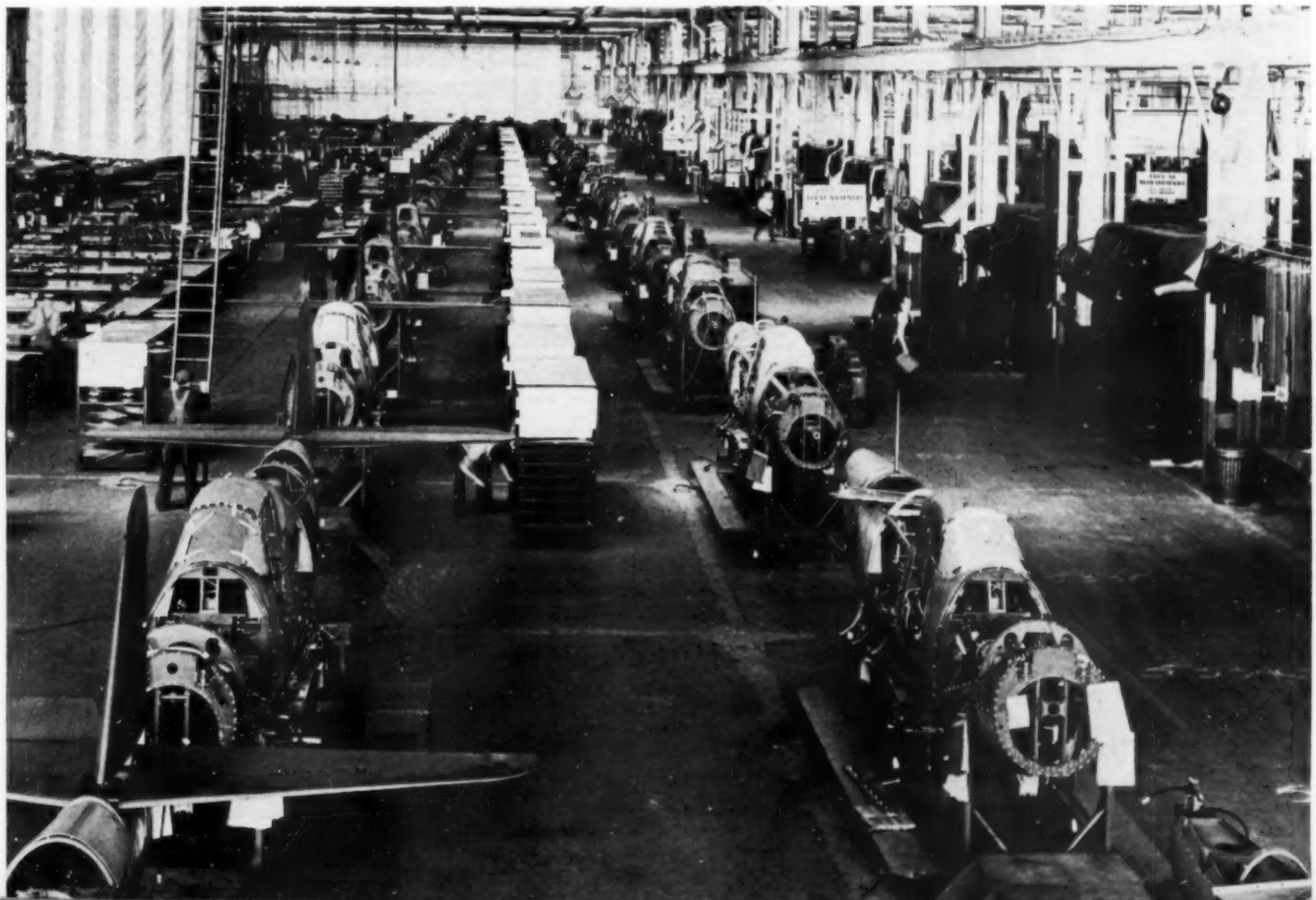
The ailerons are made of metal with a doped fabric covering, and are of the balanced slotted type. A trim is located on each aileron, controlled from the cockpit. A feature of their design and aileron control system is the combination of a venturi-shaped slot with a rounded modified friese-type nose balance actuated by a differential link motion in the control system. The assembly fixture for the aileron is shown in Fig. 17. The pre-assembled leading edge, complete with the spar, is cradled in base brackets shaped to fit the contour of the nose. The assembly is held in lateral alignment by swivel blocks at the end of the fixture. Ribs are clecoed while held in position by the contour blocks on the top horizontal member that can be raised and lowered. After the ribs are riveted and the trailing edge applied, the horizontal member is raised and the structure removed for application of the fabric covering.

Hand stitching the fabric covering to the ribs of the control surfaces used to be one of the bottlenecks of production, but Bell Aircraft engineers solved this problem by designing thin aluminum alloy strips, which are forced into slots in the ribs by a special tool—thus holding the fabric tightly in place. Tests conducted under Air Corps supervision proved that these strips hold the fabric more tightly in place than the conventional method of attachment, and time savings of 50 percent or more are possible.

The wing tip assembly fixture is shown in Fig. 18. In the foreground are shown three struts and two ribs which form the wing-tip skeleton. The wing-panel attaching rib is first bolted to a contour plate and the remaining pieces are applied, clecoed and riveted into place. The skin is then applied and held by cleco clamps as shown in the fixture to the rear. After the skin is clecoed the wing tip is removed and set flat on a work bench for riveting through access holes at the attaching point to the wing.

The tail surfaces of the Airocobra are full-cantilever units. The fixed members are of all-metal construction, while the movable control elements are fabric-covered metal frames. The assembly fixture for the fins is shown in Fig. 19. The front and rear beams *A* and *B* as well as the ribs and rudder brackets are subassembled before placing in this fixture. The ends of the spars and the rudder brackets are pinned in the fixture, after which press-formed ribs are riveted between the spars to complete the skeleton frame. The skin, previously predrilled with

Fig. 22—The two assembly lines at Buffalo are producing Airacobras for the British Royal Air Force. The fuselages are cradled in dollies which are moved from station to station on timetable schedules



all rivet holes, is bolted to the skeleton through prelocated coordinating holes in the spars and ribs. The balance of the holes in these structural members is then drilled through skin, after which the rivets are applied.

The rudder is assembled in the fixture shown in Fig. 20. The spar and leading edge, complete with cast brackets for attachment to the fin, are preassembled before placing in this fixture. The ribs are set in place and clecoed to the front spar. Then the trailing edge is applied and held in place with contour clamps placed at the rib locations. The holes for coordinating the location of the ribs and trailing edge are jig drilled, the jig being a part of the contour clamps at the tail end of the ribs. After drilling the trailing edge and the tail end of the ribs, the assembly is riveted and covered with fabric.

With the exception of shearing, routing, drilling and stamping the basic structural elements for the Airacobra, which are done at the Buffalo plant, all the assembly fixtures herein described are found in both the Buffalo and Niagara Falls plants. Bell has four assembly lines now in operation, two at Niagara Falls building Airacobras for the United States Army Air Corps, and two at Buffalo producing for British Royal Air Force. At both plants subassembly departments are so located that their own production lines feed into the correct station along the assembly lines. The layout of the Niagara Falls plant is shown in Fig. 21.

The first four stations on the line complete the assembly and installation of units inside the fuselage, so that the engine may be installed at station five. From here on, all subassembly lines feed into the main assembly line. At station six, the pilot's cabin is attached, after having been subassembled elsewhere in the plants.

At station nine, the rear section of the fuselage is attached, control surfaces having previously been attached to this assembly, and small parts are installed at the next three stations, with armor plate, fuselage armament and landing gear being attached at the final stations. At each of the stations along the final assembly line is located a storage rack in which are kept the parts to be installed at that station. A checking system on charts keeps a running record of the materials on hand, thus preventing shortages and work stoppages.

When the Airacobra rolls off the line, it is ready for attachment of the wings—which have themselves passed along their own assembly line. They are then delivered to the Air Corps or boxed for shipment.

The assembly lines at the Buffalo plant shown in Fig. 22 move manually, with timetable schedules being set up for the movement periods. At the new Niagara Falls plant, constant motion of a fraction of an inch each minute is provided the two assembly lines by endless chain conveyors, sunk into the floor, to which the jigs are hooked. These assembly lines are shown in Fig. 23.

Fig. 23—The assembly lines at Niagara Falls move mechanically, the fuselage cradles being hooked to conveyor chains sunk into the floor. With the aid of these lines Bell is producing planes at a rate seven times greater than that at the first of the year

AMERICAN MACHINIST REFERENCE BOOK SHEET

Tolerances for Spur and Helical Gears—I

A Recommended Practice adopted by the American Gear Manufacturers Association

FOREWORD

THIS IS a tentative standard, subject to frequent revision, pending eventual acceptance as an A.G.M.A. standard.

It is intended to form a practical basis upon which gears can be manufactured, inspected, sold or purchased, although it is not necessarily a rigid specification. It is emphasized that ultimate performance is the final criterion in the acceptance or rejection of gears, regardless of whether they meet definite tolerances. In other words, if gears run quietly and smoothly, and carry their rated load without breakage or appreciable wear, they will be acceptable for many applications. But when gears fail to perform satisfactorily, definite inspection methods and tolerances are invaluable in locating the cause.

An important consideration is that of the relation of cost to accuracy. Production of gears to the closer tolerances always costs more, and in some instances, stipulation of the closest tolerances may result in a cost several times what it should be.

DIAMETER RANGE

The diameters considered are from $\frac{3}{4}$ to 100 in., arranged in a geometric progression; namely, $\frac{3}{4}$, $1\frac{1}{2}$, 3, 6, 12, 25, 50 and 100 in. Tolerances for diameters other than those listed may be obtained by interpolation.

PITCH RANGE

The pitches considered are from 1 to 32 diametral pitch, arranged in a geometric progression; namely, 1, 2, 4, 8, 16 and 32. Tolerances for pitches other than those listed may be obtained by interpolation.

CLASSES AND SPEEDS

Four classes of gearing are listed according to use. These are:

Precision high-speed	...over 2,000 fpm.
Commercial high-speed	..up to 2,000 "
Commercial medium-speed	.....up to 400 "
Low speed	.....up to 80 "

These classes of gears and their definitions in terms of speed are arbitrary. The names "precision high-speed", etc. are assigned merely for convenience. There are cases when tolerances for precision high-speed gears are applicable for lower speeds, for example: timing mechanisms, dividing gears, gun-sighting gears, etc. Likewise, the tolerances for the low-speed and medium speed gears may be satisfactory for higher speeds in some instances. The speed ranges of 80, 400 and 2,000 are arranged in a geometric progression.

TYPES OF ERRORS

The fundamental errors of gear teeth for which tolerances are given are:

1. Runout
2. Pitch error
3. Accumulated error
4. Profile error
5. Lead error

Tolerances for backlash are not included because of the separate A.G.M.A. adopted standard for backlash (for spur gears only). Tooth thickness and pitch-diameter measurements are related to backlash and are likewise omitted.

Tolerances for combined-error tests of various sorts are omitted for simplicity, although their value for routine checks is recognized.

Tolerances for various dimensions of gear blanks, such as hole size, outside diameter, face width, etc., are not yet established, but may be ultimately included because of their importance to accuracy.

Tolerances for tooth-surface finish and for quietness are considered beyond the scope of this practice.

In order to clarify the meaning of the five types of errors considered, each is defined and explained briefly.

1. *Runout*

Runout of a gear is the total difference between high and now readings of a dial indicator suitably arranged to denote the off-center relation of the axis of the tooth profiles with respect to the gear journals or the axis about which the gear rotates. It is twice the eccentricity. It includes the effect of side runout or wobble.

Runout may be measured by an idicator applied to the bottom lands of tooth spaces, provided the bottom lands have been milled or hobbed simultaneously with the profiles.

Runout of teeth roughed deeper than the finish cut may be checked by a pin or V-block placed in the tooth spaces to actuate the indicator. However, such readings may be affected by pitch errors and should be interpreted accordingly.

It may be measured by an indicator applied at the outside diameter of the teeth if a topping milling cutter or hob has been used.

It may also be measured by observing or graphically recording the center-distance variation when rotated tightly in mesh with a master gear, excluding the effect on such center distance variation caused by profile errors, errors in spacing, interference, etc.

On wide-face gears, the runout may vary appreciably across the face width, and consequently should be measured near both faces. Appreciable difference in runout near the two faces of a gear is an indication of wobble, which is more serious than uniform runout because it prevents contact across the entire face width, and is equivalent to lead error.

2. *Pitch Error*

Pitch error of a gear is the maximum difference between any two successive tooth-to-tooth readings, converted to represent a measurement on the pitch circle between corresponding sides of adjacent teeth.

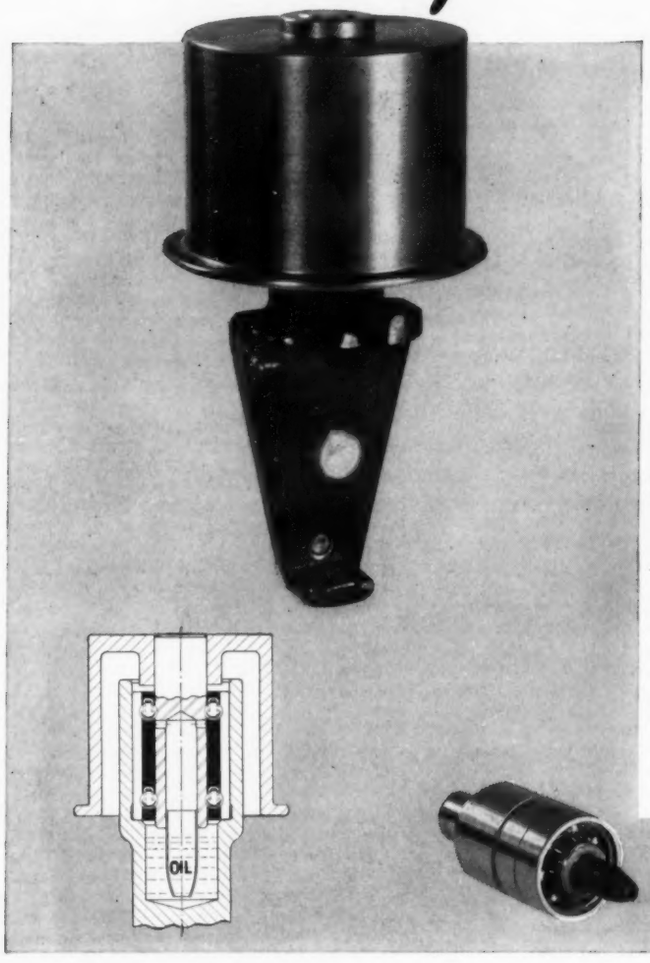
Either set of profiles may be used for tooth-to-tooth readings, but preferably the driving sides if the gear operates in one direction only. Regardless of whether or not a gear operates in both directions, it is ordinarily unnecessary to take tooth-to-tooth readings on both sets of profiles, provided both sides of the teeth were generated or cut simultaneously.

Tooth-to-tooth readings may be taken by using a device consisting of a pair of fingers, one fixed and the other actuating a dial indicator, both of which are mounted on a movable block or slide, with some means to return the slide accurately always to the same position. A spring-tension device is desirable to keep a definite uniform tension of the gear against the fixed finger. The indicator is set at zero or some arbitrary reading for the first pair of teeth, and all readings between successive pairs of teeth are relative to the first reading. In interpreting the readings, it is important to note that the readings are not errors; it is the *differences* between successive pairs of readings that denote pitch variation.

The pitch-error readings may or may not be influenced by the runout, depending upon whether the stop on the indicator slide operates against a stop external to the gear, or against the bottom lands of the teeth or the outside diameter if a topping cutter has been used. It is preferable to have pitch-error readings independent of runout, because runout is mainly a function of blank processing and set-up and can be readily determined separately, whereas pitch errors are mainly a function of the gear-cutting machine or cutter. However, on gears with high numbers of teeth, the runout effect on tooth-to-tooth readings is so gradual that it may be ignored, unless the readings are to be used subsequently as a basis for deriving accumulated error.

A plane of rotation has been selected as the plane of measurement, because diametral pitch has been arbitrarily selected as a basis for establishing tolerances. In the case of spur gears or helical gears having low helix angles, the tooth-to-tooth readings may be readily taken in the plane of rotation, but at higher angles the indicator finger may give false readings from the side cramping effect of the helical teeth. In such cases, readings may be

inside it's always *raining*



● Yes, a continuous shower of tiny drops of oil inside this Tension Pulley Ball Bearing keeps balls and raceways automatically lubricated. It is the *first* anti-friction bearing with its own oil-circulating system—a permanent built-in feature, enabling it to run for a year or more without attention.

Since the products of New Departure are *ideas* as well as ball bearings, this company has developed many "famous firsts," has revolutionized mechanical design in many industries.

Nothing rolls like a ball. Ball bearings are used wherever shafts turn. Ask for your copy of that absorbing, superbly illustrated treatise: "Why Anti-Friction Bearings." New Departure, a division of General Motors, Bristol, Connecticut. Chicago and Detroit.

New Departure

. . THE FORGED STEEL BEARING

Tolerances for Spur and Helical Gears—II

taken in a plane normal to the helix angle, and converted to the plane of rotation for purposes of comparison and standardization by dividing by the cosine of the helix angle.

If desired, base-pitch error may be measured instead of pitch error. However, base-pitch error includes the effect of profile error as well as pitch error. Therefore pitch tolerances given in the table are not interchangeable with base-pitch tolerances. The base-pitch tolerances may be greater or smaller than the pitch tolerances depending upon the method of gear cutting.

3. *Accumulated Error*

Accumulated error of a gear is the maximum accumulation of pitch errors obtained by algebraic addition of tooth-to-tooth pitch errors.

In deriving the accumulated error, the tooth-to-tooth pitch errors must be corrected with reference to the true pitch.

In this example given at the right it will be seen that the maximum accumulated error occurred over three teeth.

Unless otherwise specified, accumulated error is checked over the entire 360 deg. and expressed as the maximum error between any two teeth. In some cases it is measured only for ½ or ⅓ of a circle, and occasionally tolerances are set for accumulation over any three or four adjacent teeth.

Accumulated error may also be obtained by comparing the tooth alignment with a master gear placed adjacent to it, or by comparing tooth spacing with divisions on a master graduated plate or circular table.

Accumulated error may or may not include the effect of runout, depending upon how it was derived. In setting the tolerances it was assumed that it does not include the effect of runout.

For low-speed and medium-speed gears, accumulated error is of minor importance unless the gears are to be used for timing mechanisms, dividing gears, gun-sighting devices, or the like. Even on high-speed gears, it is secondary in importance to pitch error or profile error.

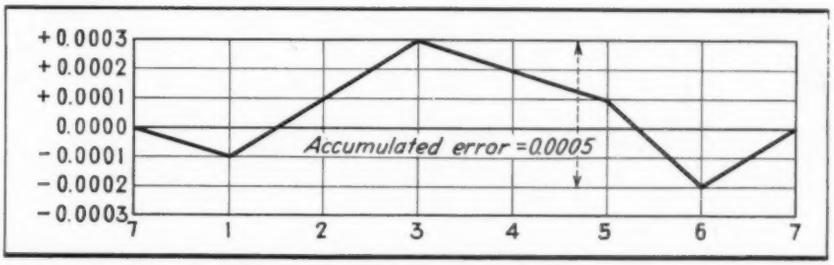
Accumulated error may be derived for any gear for which tooth-to-tooth readings are available, although it is a rather tedious check to make on large gears. As a matter of fact, an occasional check to see that the gear-cutting machine is cutting within the desired accumulated-error tolerance is usually all that is necessary.

(*To be continued in an early number*)

DERIVATION OF ACCUMULATED ERROR BY ALGEBRAIC METHOD

From Tooth-to-Tooth Readings for a 7-Tooth Gear

HEADINGS	CORRECTED READINGS	ACCUMULATED ERRORS	
Indicator initially set at +0.0005	Subtract +0.0006 from each reading	From algebraic addition of corrected readings	
		0.0000	
+0.0005	−0.0001	−0.0001	
+0.0008	+0.0002	+0.0001	
+0.0008	+0.0002	+0.0003 Max.	0.0005 Accumulated Error
+0.0005	−0.0001	+0.0002	
+0.0005	−0.0001	+0.0001	
+0.0003	−0.0003	−0.0002 Min.	
+0.0008	+0.0002	0.0000	
7) +0.0042	Total 0.0000	Check	
+0.0006 Average			



SPUR- AND HELICAL-GEAR INSPECTION TOLERANCES *

CLASS	DP	Runout of PD, Total Indicator Reading								Pitch Error Measured on Pitch Circle in Plane of Rotation								Accumulated Error Between any 2 Teeth Exclusive of Runout Effect							
PD		¾	1½	3	6	12	25	50	100	¾	1½	3	6	12	25	50	100	¾	1½	3	6	12	25	50	100
Precision		..	..	..	10	10	12	14	..	..	..	..	3½	4	4	4	..	..	..	..	10	10	12	20	..
High-	8	..	..	10	10	10	12	14	16	..	..	2½	2½	3	3	3	..	..	..	10	10	10	12	20	30
Speed over	16	..	10	10	10	10	12	14	16	..	2	2½	2½	2½	3	3	3	..	10	10	10	10	12	20	30
2,000 fpm.	32	10	10	10	10	10	12	..	..	2	2	2	2	2½	2½	..	..	10	10	10	10	10	12	..	..
Commercial	2	..	..	..	20	20	25	25	30	..	..	..	5	5	5½	6	6	..	..	..	20	20	27	43	70
High-	4	..	..	10	20	20	25	25	30	..	..	3½	3½	4	4	5	5	..	..	15	15	15	21	33	53
Speed	8	..	10	10	15	20	25	25	30	..	3½	3½	3½	4	4	5	5	..	15	15	15	15	15	30	45
Up to	16	10	10	10	15	20	25	25	..	2½	2½	3	3	3½	3½	4	..	15	15	15	15	15	15	24	..
2,000 fpm.	32	10	10	10	15	20	25	..	..	2	2	2½	2½	3	3	..	..	15	15	15	15	15	15	..	..
Commercial	1	..	..	..	..	30	35	40	45	..	..	..	..	25	35	45	60								
Medium-	2	..	..	..	20	20	25	30	35	..	..	..	10	15	20	25	30								
Speed	4	..	..	20	20	20	25	30	35	..	..	5	6	7	8	9	10								
Up to	8	..	15	15	20	20	25	30	..	..	5	5½	6	6½	7	7	..								
400 fpm.	16	15	15	15	20	20	25	30	..	3½	3½	4	4	4½	5	5½	..								
Low	1	..	..	..	..	70	90	90	100	..	..	..	..	50	75	125	180								
Speed	2	..	..	..	60	60	80	80	90	..	..	..	40	50	70	100	150								
up to	4	..	..	50	60	60	80	80	90	..	..	30	40	50	60	90	120								
80 fpm.	8	..	30	50	60	60	80	80	..	..	15	20	25	30	35	35	..								
	16	30	30	50	60	60	80	..	..	15	17	20	23	25	..	..	..								

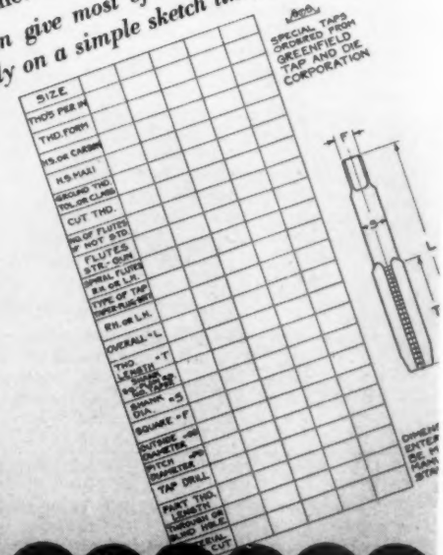
*All Readings in Ten-Thousandths

14 POINTS on SPECIAL TAPS

OLDSTERS remember Woodrow Wilson's "14 points." Here are 14 that are often overlooked, which have to do with ordering special taps. If you can remember to check each one when you order (and furnish a sketch or blueprint, too) your special taps will be *right* and properly suited to the work to be performed.

1. State exact cutting size, number of threads per inch, and form of thread. (If Multiple Thread, state the *lead* in inches and whether Double, Triple, etc. Example: 1"—8 Acme ¼" Lead Double.)
2. Is right or left hand thread required?
3. What style of tap is wanted, Taper, Plug or Bottoming Hand Tap, "Gun" Tap, Nut Tap, Tapper Tap, Pulley Tap, etc.?
4. Should taps be High Speed or Carbon Steel?
5. Are taps to be furnished with cut or ground threads?
6. If threads are to be ground, what class of fit is to be produced?
7. What is overall length; thread length; and style, length and diameter of shank?
8. How many flutes, if not standard, and shall they be straight, spiral or "*Gun*?"
9. If spiral flutes are wanted, should they be right or left hand spiral?
10. What length of thread is to be cut?
11. Will tap be used in "through" or blind holes?
12. What is size of hole before tapping, and what is depth of hole to be tapped?
13. What kind of material is to be tapped?
14. Are taps to be used by hand or in a machine? If machine, advise type.

You can give most of the information briefly and correctly on a simple sketch like this.



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TAPS · DIES · GAGES · TWIST DRILLS · REAMERS · SCREW PLATES · PIPE TOOLS

This is one of a series of advertisements published by Greenfield Tap & Die Corporation to help users get greater production from their small tools in these critical times, through making useful facts more widely known

Stop Strikes "For the Duration"

AN ENGLISHMAN tells us that our labor situation reminds him of France under the Popular Front rule and of Italy just prior to Mussolini. He is profoundly disturbed. And so are we.

What is the scene which he looks upon?

John L. Lewis thrice defying the President and finally consenting to put his case before the National Defense Mediation Board, but threatening another coal strike in captive mines if the closed shop is not granted.

The Federation of Long Lines Telephone Workers warning the President that telephone communications vital to national defense will be halted by a strike unless the union's dispute with the A. T. & T. is certified to the Mediation Board.

A jurisdictional fight between two A. F. of L. unions holding up production since September 19 of a certain type of copper wire urgently needed by the Army Signal Corps.

Two powerful unions, the C.I.O. and the A. F. of L., battling with each other over jurisdictional rights, more than half the strikes recently in defense industries having been of that nature.

Union leaders privately admitting that regardless of attempts by defense authorities to prevent further critical shutdowns of production, the hard push for the closed shop will continue to be the main union objective.

All of this can hardly be inspiring to Americans or Englishmen. At a time when the government is pleading with industry and labor for a supreme production effort, it is a depressing sight (and one which must be a delight to the Axis powers) to see labor leaders engrossed in their own selfish affairs.

Picture for yourself the furore that would be created if an important defense manufacturer announced publicly that if he didn't get what he wanted in his relations with his men by a specified date, he would cease production. He would be damned from one end of the country to the other! And the government would be the first to put on the screws. Union officials, however, feel that they are immune to such indignation. But are they?

The latest Gallup poll shows that 73 per cent of the public favors the government's forbidding strikes in defense industries. And that sizable majority has been maintained in the polls over the last year.

England has forbidden strikes so long as the war lasts. Canada has not gone so far, but strikes lately in the Dominion have been few, and they have been extremely unpopular with the people.

True, we are not formally at war, as Britain is. But we are skating perilously on the edge of it. So far as Washington is concerned, we are in it. Under the circumstances it is not unreasonable to request both labor and management to cooperate wholeheartedly.

Labor leaders as well as manufacturers should shelve selfish motives "for the duration." If they refuse, we believe that Congress should take appropriate action to compel them to. Anything which interferes with our arming ourselves and our allies as quickly as possible is a menace to our national safety.

Burnham Finney

GAGING BUSINESS

Russia orders machine tools for delivery as far away as 1943. British complain of Lend-Lease red tape. Aircraft engine production running 5,000 monthly. Tank makers build 700 a month

Soviet Russia has placed machine-tool orders in the United States totaling over ten million dollars. Some of the equipment is for delivery as long distant as 1943, an indication of Stalin's confidence that his armies can hol dout indefinitely against the Nazis. The machine tools are intended to build up Russia's munitions industries East of the Urals. Both Russia and Britain are seeking in this country not only the tanks, airplanes and other weapons of war which they badly need, but also machine tools so that they can expand their own ordnance-producing facilities. It appears certain that the flow of machine tools to England will be increased, though not to the full volume that the British Government would like.

Machine Tools—The amount of machine tools which defense work will require in the next two years has grown to $2,500,000,000. Many machine-tool builders complain that too much time elapses between the date when munitions production programs are decided upon and the date when machine-tool orders for these programs is placed. In the case of bombers, the last contracts for machine tools have just been let, though the program was mapped out late in 1940. The British are complaining that Lend-Lease red tape is slowing down the securing of machine tools for delivery to empire points, the procedure being cumbersome compared with the method used prior to Lend-Lease. The complaint is that three or four months go by between the time an order is placed and work begins. OPM is now ready to issue a revised master preference numerical list of defense contractors to be used in scheduling deliveries of critical machine tools. This list will replace the one sent out in July. Anti-aircraft gun makers and tank builders are reported high on the priorities rating. Machine tools are needed quickly for manufacturers of ship propulsion machinery who must expand their output in a hurry to keep abreast of the greatly quickened pace of ship construction. The machine-tool industry is edging its production upward from an all-time high schedule of about $850,000,000 a year.

Munitions—Production of tanks during October is reported to have been about 700 units, of which 400 were the 13-ton light tanks and 300 the 28-ton medium tanks. By the end of the year output is expected to rise to 1,200 a month. Of that number 500 will be light units and 700 medium units. By July 1, 1942, it is anticipated that tanks will be coming off American assembly lines at a rate of 2,000 units a month, of which 1,200 will be of the medium type. Thereafter a sharp expansion in operations should boost production to 3,500 units a month by the late fall. Modest production of 60-ton tanks should be under way in the final quarter of next year, and perhaps sooner. Conversion of industrial capacity in the metal-working field from peacetime to defense production is proceeding at a highly accelerated rate. Before long all high-explosive shell, regardless of size, will be made of heat-treated SAE 1040 steel instead of the current X1340 air-hardening steel. This action will save manganese, but probably will have little effect upon shell processing plants except for the need for installing suitable heat-treating and washing equipment.

Shipbuilding—The first of the simplified emergency (so-called "ugly duckling") ships has been delivered to the British government. It is one of the 60 ships of this type originally ordered by the British from the Todd-California and Todd-Bath Iron shipyards. The Maritime Commission later adopted the design (with an oil-burning instead of a coal-burning power plant) and has ordered 312 of them. The first ship, the SS Ocean Vanguard, was laid in the ways April 14, was launched August 16 and was delivered October 27.

Steel—Direct allocation of all types of steel to replace priorities appears certain. Close to 40 percent of all steel output will be allotted to defense users. Of the remaining 60 percent, over half will be allocated to individual consumers and a little less than half to warehouses for distribution without allocations. A relatively small tonnage will go into a government pool to meet the needs of companies threatened with extreme hardship or extinction. Defense authorities as well as steel companies are convinced that much of the recent pinch in steel is traceable to hoarding by users.

Aircraft—Aircraft engine production is about 5,000 units a month and will increase substantially as new plants at Detroit and Chicago get going. Plane output, according to tentative schedules, calls for 2,500 planes a month by the year's end, between 3,000 and 3,500 a month by next June and over 4,000 a month by July, 1943. Trainer production will stay at approximately 1,000 a month. There may be a dip in airplane assemblies because of the substitution of heavy bombers for lighter ships. Obviously the bigger planes take much longer to build than the smaller ones.

GOVERNMENT DEFENSE ORDERS IN BRIEF

AIRCRAFT—Deliveries of repair parts for civilian operated airplanes were granted an A-10 preference rating in an amendment to Order P-6-a. Preference Rating Orders P-3 and P-4 for manufacturers of airframes and aviation engines and propellers have been extended until Dec. 31.

AUTOMOBILES—Conservation Order M-9-c forbids use of bright finish, bright work, metal finish or body trim containing aluminum, copper, nickel or chrome after Dec. 15, except with special permission for bumpers.

COBALT—General Preference Order M-39 restricts deliveries and acceptances of cobalt for metallic uses to specific authorizations. Non-metallic deliveries are limited to 90 per cent of shipments in first six months, 1941.

FARM MACHINERY, EQUIPMENT—Preference Rating Order P-33 assigning preference rating B-1 to deliveries of materials needed for the manufacture of new farm machinery has been extended until November 30. Preference Rating A-5 for manufacture of milk cans and limited Rating A-5 for manufacture of hot-dip tinned and tin plate dairy equipment can be obtained by submitting PD-1 forms for steel sheet.

FIRE-FIGHTING APPARATUS—Preference Rating Order P-45 assists manufacturers of essential fire-fighting apparatus needed to fill defense orders with a preference rating of A-2.

HOISTING EQUIPMENT—Preference Rating Order P-5-b has replaced Order P-5-a for manufacturers of cranes and hoisting equipment. Ratings will be granted individually to builders on the basis of defense importance.

WASHERS, IRONERS—Limitation Order L-6 curtails production of domestic washers and ironers from Aug. 1 through Dec. 31 by 17.3 per cent below average factory sales in year ended June 30.

ZINC ALLOYS—Office of Price Administration has approved these prices for high grade zinc alloys: 11½ cents per lb. for carload lots, 11¾ cents for lots from 5 tons to a carload and 12 cents for less than 5 tons.

PRESIDENT CONTINUES TO AVOID STRIKE LAWS

Steel Studied as Substitute For Brass in Shell Casings

WASHINGTON — Experiments under way on the manufacture of steel shell casings may make the difference between a critically tight situation in copper and a relatively ample supply. Army has not made up its mind as to the practicability of the steel casing (though the Germans seem to do all right with them), but it is experimenting and also watching closely operations of the American Fork and Hoe Co., Ashtabula, Ohio, which is manufacturing steel 75 mm. casings for the Canadians.

Economy in materials of the steel casing is obvious, but there are important objections. Rustless storage has in the past been an overwhelming argument for brass, but shell move fast these days. It is thought, furthermore, that a thin copper plating would offer adequate protection. More serious is the impossibility of re-use. Army uses brass shells five times. Steel, it is feared, would be too badly corroded by powder fumes to permit more than one use; more would be needed. Add the greater difficulty of working steel and the manufacturing problem is obvious.

A more technical difficulty concerns the heat conductivity and coefficient of expansion. When the charge is detonated, a copper shell casing heats rapidly, expands and seals the breech; then it cools quickly and shrinks to permit easy ejection. It's questionable whether the same action could be obtained with steel.

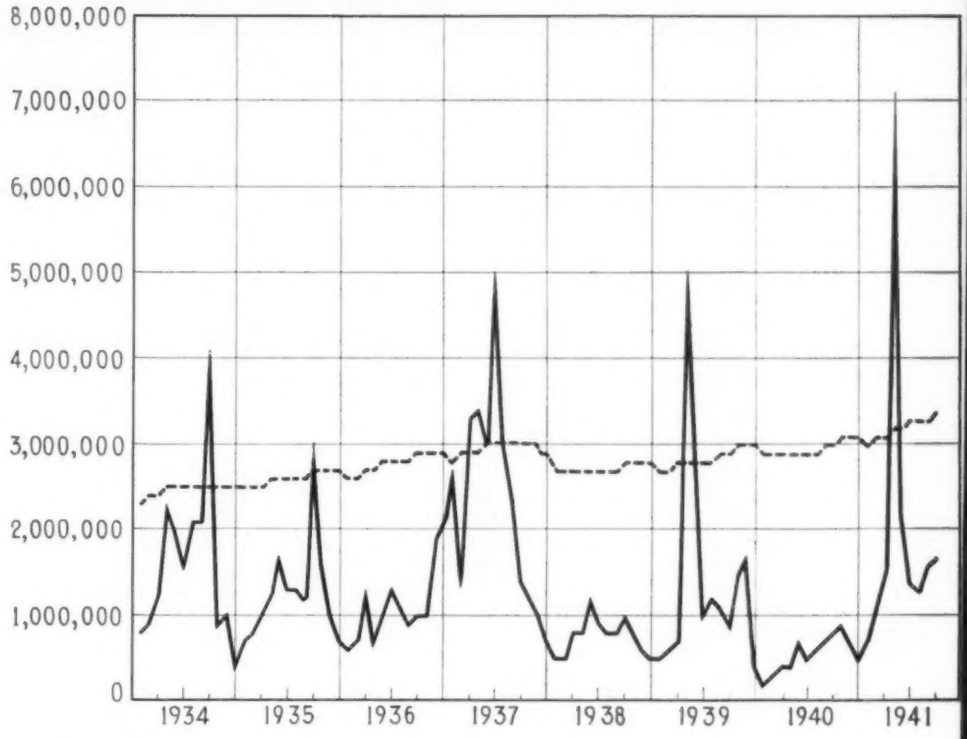
DEFENSE EFFORTS HONORED

WASHINGTON—Bell Aircraft Corporation, Chrysler Corporation and Packard Motor Car Co., received recently certificates of achievement for "exemplary success in the development and production of vital national defense requirements" from George Washington University.

AUCTIONS BUST BOTTLENECKS

BRISTOL, ENGLAND—Production bottlenecks due to tool shortages are being broken here by special auctions. Firms lacking tools sent representatives with lists of needed tools. Other firms with idle or unneeded equipment sent lists of these items. In one hour recently more than forty firms were brought together and more than one hundred bottlenecks eliminated.

Some tools are sold, some lent. All were of use in making vital munitions such as tanks, ships, guns and shell.



Strikes, Employment on the Line—*Strikes, almost non-existent during 1940, rose steeply in 1941 to make it the second worst year of the decade. Solid line represents man-days lost in strikes as reported by the Bureau of Labor Statistics. To indicate the extent to which this rise simply reflects increased employment, the broken line charts monthly employment in non-agricultural establishments (divided by ten to get a corresponding scale). A factor to be borne in mind is that many strikes do not affect defense, while employment in defense significant industries rose most*

Strike legislation seems inevitable as wages become large issue with continued price increases

BY ROBERT COLBORN

WASHINGTON—Once more the President has succeeded in his strategy of dealing with strike situations on a one-by-one basis rather than through legislation. Seizing the Air Associates plant and inducing Lewis to send his miners back to work, Roosevelt staved off for a few weeks at least the gathering pressure for anti-strike legislation.

It's a shaky victory, however, until some settlement is reached in the captive coal mines. And no matter what decision is reached, the pressure is likely to increase. If the National Defense Mediation Board supports the steel companies against Lewis, most observers think the miners would strike. A second coal strike within the year would so enrage Congress that even such a drastic move as seizing the mines could hardly placate the legislators.

On the basis of its approach to past cases and the attitude expressed in Chairman Davis's Oct. 30 speech, the Board might easily uphold the closed shop in the captive mines. This would solve the immediate dilemna (leading at the worst to another Kearny case in the captive mines), but it would probably precipitate a wave of strikes for the closed shop—a fact of which the Mediation Board is well aware. And nothing gains less public sympathy than closed-shop strikes.

Over the next few months, then, conditions strongly suggest the imminence of new labor legislation. Much depends on the attitude of the President, and this is still largely a matter for speculation. He definitely has not yet decided that legislation is necessary; none of his labor advisers are drafting bills.

FDR Strives to Avoid Laws

There is reason to think, however, that as the pressure increases, Roosevelt will not be inclined to make a last ditch fight against legislation. The President has never been an outright labor man; he was once a reformer and is now busy fighting a war. And his statements and acts of the past year, as AMERICAN MACHINIST has pointed out before, suggest that he by

no means rules out the eventual necessity of strike restrictions. Rather, he has been trying to stave it off as long as possible.

Essential difficulty in the President's position is clearly revealed in the accompanying chart. His policy was formed under one set of conditions, and he is trying to apply it in radically different circumstances.

The first year of the defense program was a year of labor peace unparalleled in the past decade. At that time it seemed highly reasonable to believe that a program of voluntary agreements with the unions, as evolved in Hillman's stabilization pacts, would practically eliminate strikes in defense industries and that meanwhile such strikes as occurred could be dealt with as special cases.

Rising Prices Bring Strikes

But Hillman only managed to complete two stabilization pacts, in shipbuilding and construction, and the second of these ran into trouble. Rising price levels in 1941 produced a wave of strikes second only to that of 1937 (Whereas only 35 percent of strikers between 1934 and 1940 were involved in wage disputes, 70 percent of this year's strikers walked out over wage issues.

Even then the administration hoped that price controls could be imposed that would halt the rise in the cost of living and restore industrial peace. But Congress dawdled over the price bill while prices soared. It is now admitted that prices of basic commodities have gone up so far that, regardless of any legislation, prices to consumers are going to keep on rising for another year.

Thus Roosevelt can have little hope that, if he waits a bit, the strikes will subside.

STANDARD PARTS FARMED OUT

EAST PITTSBURGH — Assembly forces can be built up faster than expert machinists can be trained, according to T. I. Phillips, assistant to president, Westinghouse Electric & Mfg. Co. So, Westinghouse is even farming out parts making for some of its standard products. Expert craftsmen thus are released for exacting defense production, and at the same time, standard products keep rolling off assembly lines to meet the needs of other defense manufacturers.

Defense subcontracts are being let by Westinghouse at a rate to provide 6,600,000 man-hours of work a year for the employees of more than 300 small manufacturing companies, according to Mr. Phillips. Since April the company has increased its farming out of defense work by 20 percent. First items subcontracted over a year ago were screw machine parts.

Price and Wage Ceilings Create Hardships For Canadian Industry; No Move by U. S.

OTTAWA—Canada's metal and metalworking industries are far from happy under the over-all price and wage ceilings which go into place Monday. Preliminary measurements of the impact of the new anti-inflation measures reveal widespread discrimination in the effect of both. Much of this will be leveled out in the process of administration but in the interval industrialists are on the hot seat.

Control officials recognize difficulties and anomalies in the over-all plan. So far they have attempted only an initial clarification which leaves final policy wrapped in obscurity. It will be left mainly to administrative officials and boards to solve most of the problems in the light of circumstances.

The price ceiling covers war materials and products as well as civilian goods. But it is admitted that emergency circumstances must govern largely prices paid for war supplies. In the latest regulations sales to Munitions and Supply Department are specifically exempted.

Exemption Relieves Hardships

General operation of this exemption would upset the whole plan and result in disastrous prejudice to sections of civilian industry. Authorities insist that exemption is not for general application but to meet special circumstances such as urgency in procuring war supplies which might require price premiums. It is expected, however, that it will be used to relieve some of the hardships.

Ottawa recognizes, for example, that Canadian steel producers have a legitimate protest against freezing of current prices for the duration. Over a year ago Canadian steel operators fell in with the view of Munitions Minister C. D. Howe that they should not advance prices. Prices were then virtually at the pre-war level. Nominally the ceiling order would perpetuate these pre-war prices regardless of higher costs. Some adjustment can be expected—Wartime Prices and Trade Board has specific power to adjust and vary ceilings—but whether the government will share the load through increased cost of war supplies with other big steel consumers such as the railroads is one of the unanswered questions.

Minimum Wages Bring Complaints

The wage-fixing of the over-all anti-inflation program is even fuller of anomalies. Highlighting these and giving rise to the strongest and most general complaint is the order setting minimum wages at 35¢ an hour for men and 25¢ for women in plants engaged on war orders. Hundreds of such plants are making both war and civilian goods, pay minimums to all employees.

As the minimums do not apply to civilian industry, labor costs for civilian production in plants with war orders are higher than in plants of competitors without war orders. At the same time the price ceiling wipes out any chance of getting back increased overhead. When war contracts are completed they have to face trouble in going off the minimums. Strongest kick comes from Quebec.

The only method Labor Minister McLarty and his advisers see for meeting this grievance (it is pretty certain to be adopted) is extension of the minimum rates to civilian industry. The effect will be to spread a grievance now confined to war plants to all industry. Minimum rates will boost production costs under the general price ceiling without any escape provision as in the case of war supplies sold to the government.

Maximums Going Up

Wage maximums are going up also. The principal function of the central labor control board will be to authorize upward adjustments in wage ceilings where it can be shown that rates for the base period (1926-40) are low in comparison with rates in similar employment. Purpose is to reconcile labor to the wage ceiling policy by preserving collective bargaining in some degree. To emphasize this purpose Ottawa rejected industry's plea that the board be judicial in character, not merely a super-conciliation board. With the exception of the chairman the board will consist of an equal number of representatives of industry and labor.

Officials looked to the latest Hyde Park meeting between President Roosevelt and Prime Minister Mackenzie King with a joint hope for some assurance that their anti-inflation problems might be washed out by a cooperative move towards over-all ceilings in U. S. King appears to have brought back no such assurance.

May Remit Customs Duties

With Canada currently buying in the U. S. at the rate of $700,000,000 a year, the toughest problem which develops is that of fitting rising costs of imports to the domestic price ceiling. One method is to remit customs duties and the 10% war exchange tax. The ceiling will be allowed to operate to the exclusion of imports of some non-essential commodities.

To put Canada in line with Washington's allocations system by the first of the year, Canadian importers of steel and steel products were required to supply the Canadian steel controller by the middle of this month with copies of all orders placed or pending in the U. S. machinery equipment.

MATERIAL SHORTAGES LIMIT ARMS PRODUCTION

Lifting limits on metals will greatly accelerate program, far outdoing Nazis by 1943. Copper serious after early underestimating

WASHINGTON—There is no limit on the arms production capacity of the United States except lack of materials. These limits are being lifted and by 1943 the American war engine will make Hitler's outfit look like a wood burner. Meanwhile, of nine strategic metals, some are under priorities, some are allocated, and copper is under a limiting order. One third of all the price ceiling schedules are on metals and minerals.

Strategic materials are those wholly or partly imported, subject to interruption by enemy action, and those otherwise limited below defense requirements. OPM has released a series of statements on nine scarce metals, the where-with-all of the metal-working industry.

Copper tops the list, strategically, by a good margin. We are wrong on copper for several reasons, of which the best is that everybody, including Britain, underestimated the torrent of shell it takes to attack and defend in modern war. Casings are brass which is 7 parts copper, 3 parts zinc. We are trying to make shell of steel, but Army and Navy may not accept them. Germany is using steel shell extensively, with apparent effectiveness.

Bomber Takes 500 lb. Copper

Every one knew the thousand and one defense applications of copper—a bomber takes 500 pounds of red metal, some planes take two miles of copper wire—but few realized what quantities were required. Liberal early estimates have been revised upward, will be jacked again and again.

The 1941 copper supply, in short tons, including imports, all from this hemisphere, and 100,000 tons of secondary, is 1,650,000 tons. Against an estimated consumption of 1,880,000 tons, there is a shortage for military and civil needs of 230,000 tons. Total supply for 1942 is figured at 1,800,000 tons, demand at 2,570,000 tons; shortage, 770,000 tons.

Demand figures are probably high, because Army, Navy and manufacturers have been zealously buying on the heavy side. Nelson is stopping this by strict allocation.

Expand Latin American Mines

What's being done? Mines are being expanded in Latin America; production is stimulated here under a two-price system; domestic consumers are shying away from it as a scarce material. Interesting, though not important, is proposal to substitute silver for copper in electrical bus bars, etc.

Don't worry, from a war viewpoint, about copper. We could if necessary, screw up our zeal and pass a miracle. Germany is getting along in 1941 with 115,000 tons.

Aluminum is next, because it's a new member of the metals family, suddenly elevated to near-equality with steel, and because it's the best stuff for aircraft.

Production has jumped from 224,000,000 pounds in 1936 to estimated 412,000,000 in 1940; 600,000,000 in 1941; and is estimated at 800,000,000 for 1942. Consumption in 1940 was 592,000,000 pounds, and in 1941 it would have been 1,400,000 pounds had not civilian use been curtailed.

Not Enough Aluminum

No matter how much aluminum is produced while the war lasts, it will not be enough for everybody, because it's a major component of airplanes, tanks, war ships, field kitchens, armored cars. A single seat fighter plane uses 5000 pounds, a 30-ton bomber, 20,000 pounds. When the war ends cheap aluminum will make light car frames, bridges, buildings.

The Arkansas earth is being peeled to expose our only big deposits of bauxite for swift mining, in case our 60 percent from Dutch and British Guiana should be cut off. The Axis is fat with aluminum from Europe, substitutes it for steel and other metals. But in this country, no ship, plane or tank ever waited for aluminum and probably will not. The shortage all comes out on the civilian side.

Magnesium is really short. It was the second metal to come under mandatory priorities; aluminum was first. No amount would be enough. Britain and the U. S. want multiplied millions of incendiary bombs and shell to rain fire on the enemy. And these are made of magnesium, a child element in war and industry. All the magnesium we want could be taken from a square mile of ocean water, but it takes power and plant, both slow to build. Dow Chemical Co., only producer, is now licensing the process.

Vital to Aircraft

Magnesium, too, is vital to aircraft, especially for engine crankcases and wheel casings. It is under experimentation for propellers. These took 75 percent of magnesium alloy produced in the U. S. in 1940. In that year we produced 12,500,000 pounds of magnesium; this year we will produce 30,000,000 pounds, which will be about 130,000,000 pounds short of demand. In 1942 we will turn out 150,000,000 pounds against an estimated demand of 300,000,000 pounds. Sights are aimed at 400,000,000 pounds in 1943.

Note that it's the bombs and shell that are going short for lack of magnesium, not planes.

Steel is the flesh and bone of war. All else—copper, tin, silver, diamonds, glass, brass—all are embellishments by comparison. You could fight a war on land, sea and air without aluminum;

Check Tank Checkers—*Inspectors check parts for two-pounder guns made by Canada to check Nazi tanks. Breech requires 45 operations to manufacture; entire gun takes more than 1,000*

More Fire Power—*To increase the attacking fire power of the infantry regiment, the Army will equip 973 of its men with the Winchester carbine. These men previously carried pistols which they will swap for the new gun*

good planes can be made of all steel or wood, steel and plastic. Aluminum is better, but it's a luxury in design for killing.

AMERICAN MACHINIST constantly tells the story of steel. You've read that our production is 83,000,000 tons this year; that a third of it will go into arms for our own forces and export; that SPAB recently authorized 10,000,000 additional tons of capacity in "scrambled" facilities. Production will be about 87,000,000 tons in 1942. The new plants will not be in full blast till later.

Only in a few cases of special steels has there been any delay. Special alloys will be held up only if the Axis can control the sea and stop manganese, tin and chromium imports, before we get long-term stockpiles.

Steel Plentiful for Arms

We might run short on steel exports if we have to arm most of the world to beat Hitler. But for our own arms we will lay steel on the line. For every two tons of steel in reach of Hitler, we have three.

Mr. Public will forfeit part of his share in steel in the shape of stoves, refrigerators, cars; but he will get the rest in substitutes: wood and plastic, and like it.

Then there are five strategic alloying metals: chromium, tin, tungsten, lead, and zinc, plus rubber. Other critical items are antimony, mercury, mica, nickel, graphite, optical glass. Remember the stockpile appropriations, two, three years back: They're all submerged under RFC billions and are duty-free now. Size of most stockpiles is a military secret.

Chromium is plentiful—In Africa and the Philippines. Our supply depends upon our freedom to sail the seas. Chromium is the chief source of stainless steel, principal alloy in hard armor plate, and 30 percent of demand is used to line steel furnaces. This year we are importing 800,000 tons, producing 10,000 tons, total 810,000 tons, and we are using 750,000 tons—all figures estimated. Two plants are being built in Montana, for management by Anaconda Copper Company.

Tin Outlook Bright

We have no **tin**, and none in sight, of our own. In 1940, we imported 124,810 long tons of tin, 96,454 of them from the British Malay States, 12,101 from East Indies, 44 tons from our own Alaska! The 1941 figure is estimated 150,000 tons; 1942, 165,000 tons.

The tin outlook is bright. The Treasury, the Navy, and manufacturers have one year's supply in stockpile, over 100,000 tons. And, we've got a smelter in Texas, processing ore from Bolivia, which lost its European market and is glad to have **us.** We make bronze and other alloys and type metal of tin. But over half of it goes into that true American institution, the **"tin"** can, which is essential in feeding the populace and military forces in war.

Push Domestic Production

Tungsten comes from China, and if we can keep that source open there will be no serious shortage. This year we are importing 12,000 tons and producing 6000. In 1942 we will import 4500 tons and produce 8000. The 1942 import estimate is based on the assumption that the China supply may be cut off. If it is we will be pinched, but will get by. Domestic production increased 40% in 1940 over 1939; sources in several states, and in South America are being pushed to the limit. Ninety-two percent of tungsten is used in making high speed tool steel.

Much New Lead Imported

We are using **lead** this year at the rate of 1,000,000 short tons, and we are producing 600,000 tons. The difference is made up by scrap and imports. Nearly half of our new lead comes from abroad: Mexico, Canada, Australia, Peru. Only that from the latter two countries could be stopped by military action. Storage batteries are the big lead eaters. Curtailment of automobile production automatically switches the lead over to military vehicles. Lead is poured into myriad bearings, and it substitutes in alloys for copper, zinc, aluminum. In war it runs heavily to bullets and shrapnel. It's under priorities and inventory control.

Cut Out, Galvanizing

Zinc requirements for 1942 are estimated at 1,465,000 short tons and the estimated supply is 975,000 tons, a potential shortage of nearly 500,000 tons. The shortage this year is about 310,000 tons. About one-third of our supply comes from Latin America. Our unrestricted civilian consumption is double that of armament. And there is your answer. Galvanized buckets and cans must give way to zinc ships' propellers and the thousand and one zinc die castings that go into tanks, planes, trucks, guns.

MOVIE SPEEDS TRAINING

SOUTH BEND—To speed the training of lathe operators for national defense industries, the South Bend Lathe Works has sponsored a series of 16 mm. full color sound motion pictures, "How To Run A Lathe."

Close Tolerances—*Tolerances are held consistently to 0.0001 in. in making shaping dies with this machine in Westinghouse Mfg. and Electric Co.'s small motor plant*

INSIDE DETROIT

Monthly tank program calls for 2,000 of all sizes by General Motors, Chrysler, Ford. Wide subcontracting of parts planned for these and other producers. Ford arrangements await final approval

BY RUPERT LEGRAND, DETROIT EDITOR

DETROIT—Barring change of plan, the tank procurement programs under discussion with General Motors, Chrysler and Ford will call for an eventual production of 2,000 tanks per month by these three manufacturers alone. Half would be medium tanks. General Motor's tank contracts for several sizes will far exceed those of its auto rivals.

Last week, the Defense Plant Corp. allocated $25,000,000 to Fisher Body for plant and equipment at Flint where 15,000 persons will be employed on tank manufacture. Cadillac will be drawn into the program, and Detroit Transmission will build the Hydra-Matic automatic transmission for tanks. Other companies will contribute to the program, with wide sub-contracting of parts.

Chrysler Shifting to M-4

Besides other sizes desired by the Army, General Motors will build the M-4 30-ton tank, and Ford will do likewise. Chrysler is currently building the M-3 but will shift over to the M-4. The new model differs from the M-3 chiefly in that the 75-mm. cannon is mounted in the turret to cover a wider angle of fire. Hull, transmission and undercarriage details remain largely unchanged. It has been reported that the armor plate hull of the new model will be welded, but this point still seems in doubt. The object of welding is to remove the danger from rivets punched out by bullets and flying about within the tank.

Washington reports indicate that the procurement program for medium tanks is based upon 2,000 per month. But it is understood locally that facilities for producing the basic raw materials—armor plate, armor steel castings and forgings—are being expanded to provide material for 3,000 per month.

Extra Units May Be Final Goal

The "extra capacity" of 1,000 units is regarded as a cushion to take care of troubles and delay in the supplying industries, but may complete the eventual assembly goal. This attempt to provide the raw materials in excess quantities has evidently grown out of experience at the Tank Arsenal. Although the Arsenal is currently well ahead of assembly schedule, machining lines must be stopped or undermanned on occasion through failure of castings and forgings to arrive as desired.

As announced by Chrysler, its tank manufacturing program is being enlarged. Evidently rated output will be doubled. It is expected that a 480-ft. extension for experimental purposes and additional machining will soon be added to the present 1,380 x 500-ft. Arsenal. A 100-ft. wide addition along one side of the plant to increase the assembly lines from three to six.

Coordinates Engineering Information

Plymouth is making tank parts; DeSoto is planning to duplicate a number of the Arsenal's machining lines. New structures may be erected on Arsenal property. The Arsenal functions through the medium of its Army personnel as coordinator of engineering information for medium-tank manufacturers throughout the country.

Within a week or so, Ford probably will announce definite plans to manufacture M-4 tanks. It has received a letter of intent and begun to place orders for machinery and facilities requiring long delivery. Original negotiations had been on the basis of a 400 complete units per month, the supply of tank parts to other manufacturers, creation of armor plate facilities by conversion of a rolling mill and enlargement of the new steel foundry. These plans called for expenditure of $39,000,000 on new facilities within the Rouge Plant plus between $6,000,000 and $7,000,000 for tooling. New construction would be of minor importance.

Ford Fully Prepared

Whether part or all of the original Ford negotiations go through still rests with the government. The matter remains in the letter-of-intent stage, which must be followed by formal instructions and then by a contract. Ford is losing no time meanwhile in production planning and lining up facilities.

SEEK MAXIMUM CONSERVATION

DETROIT — Maximum conservation of scarce materials for the defense program will be sought by the Committee on Critical Materials set up by the auto industry. Information on new processes and technological developments which seek to use alternate materials will be exchanged, as well as data on how critical supplies can be saved. Sub-committees under the direction of an eight man group of auto-company chief engineers will handle the work. OPM will be furnished findings to assist in planning allocations.

Working for the Navy—*Over 1,300 men are at work in the new U. S. Navy Ordnance plant operated by Hudson Motor Car Co. producing Oerlikon anti-aircraft guns. Other equipment-fire control and direction apparatus, gun mount parts, torpedo tubes and catapult guns will be made here. Workers above operate lathes*

Aircraft Producers Told Their Acceleration Of Defense Plane Making Exceeds Nazis

LOS ANGELES—With every aircraft factory in America pushing production to the limit in an effort to meet the acute need developing out of Europe's mounting holocaust, the annual aircraft production meeting sponsored by the Society of Automotive Engineers was staged this year under the shadow of desperate urgency. About 1,000 engineers and production men registered at the meeting held Oct. 30 to Nov. 1. Unregistered attendance boosted the total to 3,000.

High point of the meeting was the address by A. T. Colwell, S.A.E. president, on "Blitzkrieg and How to Stop It". Tracing the course of Germany's conquests across Europe, Mr. Colwell showed how each victory was the result of superior mechanization by the Germans backed by superior industrialization of the German nation prior to the outbreak of war.

Success Based on All-Out Effort

A successful war effort must be based on several years of all-out production of war weapons and equipment prior to the actual clash, he concluded. America's present production program, said Colwell, is providing the Democracies with the weapons and the internal combustion engines which will eventually stop and defeat the blitzkrieg.

According to T. P. Wright, OPM aircraft adviser, the American aircraft production effort has already passed both the British and German programs in the speed with which production has been accelerated. For the future there is every indication that the American aircraft production effort will shortly make it possible for the Democracies to wrest control of the air from Germany.

Auto Men Advanced

"Off the Ground—Into the Air" by H. H. Budds, F. W. Hofmann, E. E. Lundberg, H. T. Platz, and H. J. Roesch, of the Briggs Mfg. Co., read by Joseph Geschelin, editor of Automotive Industries, showed how far automobile men have advanced during the past year in adapting their plants to the production of aircraft component parts such as wings and tail groups. At the same time it was emphasized that the automobile people had learned much about production from the aircraft industry and still had much to learn.

C. E. Stryker, OPM, summarized the progress made in establishing production and engineering standards and emphasized the importance of developing standards intelligently so as to speed rather than hamper production.

Blueprints Eliminated

George Tharratt, formerly of the Douglas Aircraft Co. and now Chief Engineer for Adel Precision Products, Inc., explained the system of "Illustrated Production Breakdown" developed at Douglas and now widely used in aircraft production. Under this system blueprints are entirely eliminated from final assembly lines and workmen are supplied with perspective drawings which illustrate more graphically how the completed assembly should look, how it should go together, and what parts are in its construction.

W. B. Stout, Stout Engineering Laboratories, Inc., described the new light airplane engine which he is developing. Breaking completely with tradition, the Stout engine incorporates a wide range of new features designed to make possible "an engine that will produce 100 h.p., weight 100 lb. and cost $100." Included in the novel features are: a multi-piece crankshaft, pressed steel crankcase with welded bearing support diaphragms, roller bearing throughout, one piece connecting rods, two-speed propeller gearing, centrifugally cast steel cylinders, etc.

Other papers of special interest to production men were: "Engineering Liaison and Production Control" by Donald Kudlich, Wright Aeronautical Corp.; and "Airplane Quality Control" by J. W. Dunn, Curtiss-Wright Corp.

An engineering display featured exhibits by Bendix Aviation, Ltd., E. G. Budd Mfg. Co., The Cleveland Pneumatic Tool Co., The National Screw & Mfg. Co., Simmonds Aero-Cessories, and the Wright Aeronautical Co.

W. C. Lawrence (left) of OPM talks with Bert Hemingway and Mel Burns, both of Bendix Aviation, Ltd., at S. A. E. aircraft production meeting

Arthur Nutt, past president, Society of Automotive Engineers, with Lee Atwood, vice president, North American Aviation, Inc.

Explosions Put to Work—*Explosive rivets are being demonstrated by D. L. Lewis, Jr., E. I. du Pont de Nemours & Co. These rivets make it possible to blind rivet cheaper than by any other method. Hopes are that it will replace the standard driven rivet in many applications*

WATCHING WASHINGTON

"Victory Program" begins to emerge into definite plan. Aircraft schedules face little change. Broad restriction through price joker slips into repair rating order. House pulls teeth from price bill

By BLAINE STUBBLEFIELD

WASHINGTON—The so-called "Victory Program" with its scheduled speed-up of arms production intended to support an aggressive war in 1942-43 is slowly emerging from the stage of big talk and getting down to cases on specific weapons. As might be expected, some things are going to be stepped up a lot more than others.

Acceleration of tank schedules has already reached the stage of contracting for new facilities (see p. 1164g). Tanks are in a particularly favorable position for expansion. As an automotive vehicle, it is less strange to industry than other munitions. Mere boosting the previously low priority ratings speeds the program.

Civilian Cuts Continue

Continuing its drive to cut civil economy down to levels commensurate with a war economy, OPM this fortnight: set limits on output of iceboxes, washers and ironers, eliminated brightwork from cars, extended restrictions on light trucks and took steps to introduce simplification programs.

Based on the special situation that the industry can still go back to using wood, restrictions on ice box production took the form of limitation of steel to 35 percent less than the monthly average during the year ended June 30, 1941. Most previous limitation orders were written in units.

Broad Restriction Slips Through

Industrialists have begun to notice that one of the broadest limitations, though a mild one, slipped through unnoticed in last month's maintenance and repair rating plan. Beside granting an A-10 rating, the order limited the dollar value of operating supplies which can be used by participating firms to the dollar value used last year. With prices rising constantly, this provision can definitely reduce operations in many industries dependent on supplies of fuel, lubricants and the like.

Price Bill Weakened

All hope of early imposition of effective controls on inflation vanished when the House Committee last week reported out a bill much weaker than the not particularly forceful measure proposed by the Administration three months ago. Not only does the committee bill disregard wages and practically invite agricultural prices to rise, but it removes most of the enforcement features from the bill.

Main reliance for enforcement had been placed by the Administration in three features: (1) power to license all firms doing business under a ceiling (this prevents unauthorized people from violating the ceiling); (2) provision for triple damages to a customer who is charged more than is legal; and (3) buying and selling commodities by OPA at a loss so as to bring in high cost producers without disturbing the price structure. All have been removed.

Steel Allocated

Distribution of defense and civilian steel, over the coming months, is to be gradually shifted to an allocation rather than a priority rating basis. SPAB has directed the Priorities Division to do this in line with Donald Nelson's long-range objective of substituting definite allocations for priority ratings. First step in the present plan will be to order the steel companies to deliver definite tonnages on a specified delivery schedule on certain Army and Navy contracts.

The steel that is left over will then be distributed by the steel companies, as at present, in accordance with priority ratings. Gradually the number of projects given allocations will be stepped up until all direct military jobs are on this basis. At a later stage, the allocation procedure may be extended to indirect defense and essential civilian jobs.

The move towards allocation in steel, of course, reflects its increasing scarcity. At present some 60 per cent of production is covered by priority-rated orders. This percentage is constantly increasing (45 per cent in July, 57 in September), but even at the present percentage, only some 35,000,000 tons would be available in 1942 for civilian needs as against a demand, in the absence of restrictions, of some 58,000,000 tons.

Meanwhile, in the interests of keeping existing plant work at top efficiency—particularly the older mills that have been brought back into production by the defense demand—an A-3 rating has been assigned to repair, maintenance, and operating supply needs of steel mills. An A-1-a rating is available to repair breakdowns and an A-1-c to avert them. Unlike the regular A-10 repair and maintenance rating, the A-3 rating must be applied for to OPM.

Press Association

New and the Old—*J. Russell McGuire (left), president, Auto Ordnance Co., aims the first of the 9 mm. Thompson sub-machine guns to roll off company's production lines, while Maj. Gen. C. T. Harris, Jr., assistant to chief of Army Ordnance, tries the 250,000th caliber .45 delivered*

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $375,000)

Source	Agency	Commodity	Amount
Willys-Overland Motors, Inc., Toledo, O	War	Shell	$5,078,370
W. F. & John Barnes Co., Rockford, Ill	"	Shot	4,000,000
Electric Household Utilities Corp., Cicero, Ill	"	Boosters	854,199
National Cash Register Co., Dayton, Ohio	"	Fuzes	658,050
Timken Detroit Axle Co., Oshkosh, Wis	"	Tank parts	1,242,258
Iron Fireman Mfg. Co., Portland, Ore	"	Mount assemblies	553,796
Square D Company, Elmhurst, N. Y	"	Pilot tubes	4,689,233
Bendix Aviation Corp., Bendix, N. J	"	Airspeed indicators	1,210,320
The Yale & Towne Mfg. Co., Stamford, Conn	"	Pumps	505,000
Republic Aviation Corp., Farmingdale, N. Y	"	Maintenance parts	3,130,349
The Sparks-Withington Co., Jackson, Mich	"	Bomb hoists	633,148
Lima Locomotive Works, Inc., Lima, Ohio	"	Locomotives	562,290
American Type Founders, Inc., Elizabeth, N. J	"	Recoil mechanisms	591,100
Bendix Aviation Corp., Bendix, N. J	"	Maintenance parts	779,453
Bendix Aviation Corp., Bendix, N. J	"	Starters, switches	763,135
Jack & Heintz, Inc., Cleveland, Ohio	"	Starters	808,500
Bendix Aviation Corp., Bendix, N. J	"	Airspeed indicators	802,200
The Leece-Neville Co., Cleveland, Ohio	"	Panels, generators	648,587
The Crosley Corp., Cincinnati, Ohio	"	Release assemblies	501,000
Aviation Mfg. Corp., Williamsport, Pa	"	Propeller blades	776,000
Wright Aeronautical Corp., Patterson, N. J	"	Engine parts	559,972
Uehtorff Co., Inc., Davenport, Iowa	"	Ammunition chests	515,565
United Aircraft Corp., East Hartford, Conn	"	Engine parts	478,646
Bendix Aviation Corp., Bendix, N. J	"	Generators	393,750
General Motors Corp., Detroit, Mich	"	Guns	2,824,071
Weston Electrical Instrument Corp., Newark, N. J	"	Indicators, generators	1,206,642
American Propeller Corp., Toledo, Ohio	"	Propeller blades	12,185,050
Nash Kelvinator Corp., Detroit, Mich	"	Propeller parts	19,503,878
Bendix Aviation Corp., Bendix, N. J	"	Compasses, inverters	2,451,000
Kearney & Trecker Corp., Milwaukee, Wis	"	Machine tools	415,116
Westinghouse Electric & Mfg. Co., Dayton, Ohio	"	Generator regulators, switch relays	632,500
Crosley Corp., Cincinnati, Ohio	"	Shackles	661,032
Colt's Patent Fure Arms Mfg. Co., Hartford, Conn	"	Guns	2,580,509
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn	"	"	3,944,834
Western Cartridge Co., New Haven, Conn	"	Rifles	5,791,200
Utica Cutlery Co., Utica, N. Y	"	Bayonets	794,000
American Type Founders, Inc., Elizabeth, N. J	"	Guns	2,551,500
National Pneumatic Co., Rahway, N. J	"	"	3,848,460
United Engineering & Foundry Co., Pittsburg, Pa	"	Howitzers	1,021,377
Rockwood Alabama Stone Co., Russellville, Ala	"	Shell	1,026,150
American Brake Shoe & Foundry Co., Chicago, Ill	"	"	532,445
Atlas Imperaial Diesel Engine Co., Mattoon, Ill	"	"	770,804
Stewart-Warner Corp., Chicago, Ill	"	Fuzes	2,607,267
The S. M. Jones Co., Toledo, Ohio	"	Shot	1,400,000
The S. M. Jones Co., Toledo, Ohio	"	Shot forgings	1,200,000
Philco Corp., Philadelphia, Pa	"	Fuzes	1,020,500
Pullman Standard Car Mfg. Co., Butler, Pa	"	Shell	3,700,000
U. S. Hoffman Machinery Corp., Syracuse, N. Y	"	"	1,648,000
A. O. Smith Corp., Milwaukee, Wis	"	Ammunition	728,000
A. O. Smith Corp., Milwaukee, Wis	"	"	25,988,800
Harrington and Richardson Arms Co., Worcester, Mass	"	Pistols	2,402,982
Savage Arms Corp., Utica, N. Y	"	Rifles	30,402,000
Remington Arms Co., Inc., Bridgeport, Conn	"	"	9,808,800
Colt's Patent Firearms Mfg. Co., Hartford, Conn	"	Machine guns	1,809,150
J. G. Brill Co., Philadelphia	"	Carriages	1,042,560
General Motors Corp., Rochester, N. Y	"	Directors	1,760,640
Sperry Gyroscope Co., Brooklyn, N. Y	"	"	14,901,500
Frost Co., Kenosha, Wis	"	Cartridge cases	886,000
International Harvester Co., Milwaukee, Wis	"	Shell	734,388
Bendix, Aviation Corp., Bendix, N. J	"	Compasses, inverters	2,451,000
Packard Motor Car Co., Detroit, Mich	"	Engine parts	17,726,233
Doehler Die Casting Company, New York, N. Y	"	Tail plugs, primer	1,150,000
Aluminum Specialty Co., Manitowoc, Wis	"	Cartridge cases	446,750
Northern Engraving & Mfg. Co., LaCrosse, Wis	"	" "	448,750
Walter Kidde & Co., Inc., New York, N. Y	"	Fire extinguishers	420,330
The Leece-Neville Co., Cleveland, Ohio	"	Generators	375,300
Rock-Ola Mfg. Corp., Chicago, Ill	"	Ammunition boxes	951,333
Tokheim Oil Tank and Pump Co., Fort Wayne, Ind	"	Shot	2,791,090
Detroit Harvester Co., Toledo, Ohio	"	Cartridge cases	1,650,000
Scoville Mfg. Co., Waterbury, Conn	"	Fuzes	1,273,965
Darling Valve & Mfg. Co., Williamsport, Pa	"	Shell	595,680
Philco Corp., Philadelphia, Pa	"	Fuzes	549,500
John Wood Mfg. Co., Conshohocken, Pa	"	Galvanized steel boxes	982,100
Cincinnati Milling Machine & Cincinnati Grinders, Inc., Cincinnati, Ohio	"	Milling machines	500,580
Cincinnati Milling Machine & Cincinnati Grinders, Inc., Cincinnati, Ohio	"	Milling, cutter machines	519,449
R. K. LeBlond Machine Tool Co., Cincinnati, Ohio	"	Lathes, and drilling, boring, rifling machines	1,111,799
U. S. Cartridge Co., Baltimore, Md	"	Cartridges	1,157,200
General Motors Corp., Detroit, Mich	"	Guns	9,489,570
General Time Instrument Corp., LaSalle, Ill	"	Fuzes	965,000
Pullman Standard Car Mfg. Co., Butler, Pa	"	Shell	945,000
Hydril Co., Rochester, Pa	"	"	414,610
General Motors Corp., New York, N. Y	"	Hardware	385,190
Mesta Machine Co., West Homestead, Pa	"	Gun carriages	7,430,000
Inland Steel Co., Chicago, Ill	"	Steel bars	791,700
U. S. Motors Corp., Oshkosh, Wis	"	Generating units	2,299,770
Galvin Mfg. Co., Chicago, Ill	"	Receivers	1,736,042
Westinghouse Electric & Mfg. Co., Dayton, Ohio	"	Generators	685,000
Northrop Aircraft Inc., Hawthorne, Calif	"	Airplanes	18,411,812
Douglas Aircraft Co., Inc., Santa Monica, Calif	"	" "	9,709,616
P. R. Mallory & Co., Inc., Indianapolis, Ind	"	Bomb rack releases	468,000
Rogers Bros. Corp., Albion, Pa	"	Trailers	1,425,695
General Motors Corp., Detroit, Mich	"	Trucks	707,811
Diamond T Motor Car Co., Chicago, Ill	"	"	4,098,570
Mack Mfg. Co., Allentown, Pa	"	"	3,330,618
Yellow Truck & Coach Mfg. Co., Pontiac, Mich	"	"	4,426,020
Yellow Truck & Coach Mfg. Co., Pontiac, Mich	"	Van body trucks	681,480
North American Aviation, Inc., Inglewood, Calif	"	Airplanes	6,352,650
Douglas Aircraft Co., Inc., Santa Monica, Calif	"	"	6,061,385
Vega Airplane Co., Burbank, Calif	"	Airplane parts	147,790,500
Bendix Aviation Corp., Bendix, N. J	"	Aircraft instruments	27,909,314

"ALCLAD" RELEASED

PITTSBURGH—Rights to the registered trademark "Alclad" have been relinquished by the Aluminum Company of America, so that it can be used by other producers of similar duplex aluminum materials. The name is a convenient means of identifying the product made by all companies and release makes it unnecessary for each producer to develop a trademark.

NAMES in the NEWS

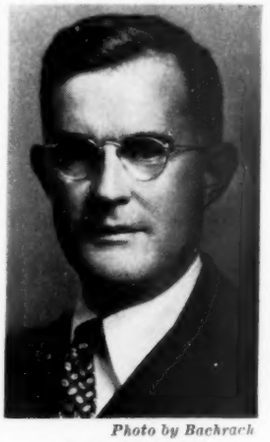


Photo by Bachrach

J. S. CHAFFEE

John S. Chaffee, with Brown & Sharpe Mfg. Co., Providence, R. I., since 1919, has been elected a vice president. He served in manufacturing departments, as assistant secretary of the company, as foreman of the small tool department and in the sales department. Cecil W. Machon, for many years manager of small tool and cutter sales and grinding machine sales, was elected general sales manager. William H. Bennett retired on Oct. 1 after 43 years as representative on small tools in western New York State for Brown & Sharpe Mfg. Co. and Brown & Sharpe of New York, Inc.

Fay Aller, chief engineer, Gage & Machine Tool Division, Sheffield Corp., Dayton, Ohio, has been named director of research. Albert Wartinger, chief engineer, Tool & Die Division, was promoted to chief engineer for the corporation.

William Bamford, Sr., formerly of Wykoff Steel Co., has been appointed production engineer for S. F. Bowser & Co., Inc., Ft. Wayne, Ind.

George A. Landry, manager, Central Office Division, Western Electric Co.'s Hawthorne Works, Chicago, Ill., was appointed head, Staff Branch, Production Division.

Robert M. Gibson, Koppers Co., Bartlett Hayward Division, Baltimore, Md.,

New General Electric Vice Presidents

E. D. SPICER

D. C. PRINCE

W. R. G. BAKER

H. A. WINNE

C. H. LANG

has been transferred to American Hammered Piston Ring Division, as engineer. He has been with the company since 1923, serving as sales engineer of equipment for blast furnace, steel plant and process industries since 1937.

Harold M. Lochrane, designing and operating engineer, recently joined Kaydon Engineering Corp., Muskegon, Mich., in charge of methods and standards.

W. J. Sampson, Jr., has been appointed general manager of sales, Steel & Tubes Division, Republic Steel Corp., Massillon, Ohio, to succeed L. W. Harston, resigned.

Brigadier General John B. Rose, formerly in command of Aberdeen Proving Ground, Maryland, has been transferred to the command of Picatinny Arsenal, Dover, N. J., to succeed Brigadier General Edward M. Shinkle on terminal leave pending retirement. Brigadier General Rolland W. Case, in command of Watertown Arsenal, Watertown, Mass., will succeed General Rose at Aberdeen Proving Ground.

Walter R. G. Baker, General Electric Co., Schenectady, N. Y., was elected vice president in charge of Radio and Television Department, of which he has been manager since 1939. Four other vice presidents were elected to serve on the staff of the Apparatus Department as follows: Chester H. Lang, continuing as manager of apparatus and in charge of defense activities; David C. Prince, formerly manager of commercial engineering department, in charge of application engineering; Elmer D. Spicer, assistant to vice president in charge of general manufacturing since last May, in charge of manufacturing; and Harry A. Winne, previously assistant to vice president, in charge of general engineering.

K. C. Stevens, vice president and superintendent, Pittsburgh & Conneaut Dock Co., Conneaut, Ohio, and assistant to president and manager, Pennsylvania & Lake Erie Dock Co., Fairport, Ohio, has been elected president of both to succeed the late George S. Meek. Clyde L. Ross was elected vice president and will continue as auditor and assistant secretary. George H. Bruce was appointed assistant to general superintendent.

PLANT EXPANSION

The Defense Plant Corp., subsidiary of the Reconstruction Finance Corp., has authorized the following lease agreements for plant and machinery expansion:

Fleetwings, Inc., Bristol, Pa., $354,035.

Ford Motor Co., Dearborn, Mich., $9,788,916.

Goodyear Aircraft Corp., Akron, Ohio, $4,343,671.

International Industries, Inc., Ann Arbor, Mich., $55,900.

Command Army Arsenal, Proving Ground

BRIG. GEN. R. W. CASE

BRIG. GEN. J. B. ROSE

North American Aviation, Inc., Inglewood, Calif., $954,099.

Omaha Steel Works, Omaha, Neb., $100,000.

Reynolds Metals Co., Louisville, Ky., $279,419.

Woodward Governor Co., Rockford, Ill., $152,656.

Wisconsin Axle Corp., division of Timken Detroit Axle Co., Oshkosh, Wis., is erecting an addition to its plant.

Fairbanks, Morse & Co., Beloit, Wis., will spend $5,500,000 for a new building and equipment to triple production of diesel engines for United States Navy.

Giern & Anholtt Tool Co., Detroit, Mich., is adding 30x200 ft. to their plant for use as erecting shop for heavy duty carbide borers.

Standard Tool & Gage Corp., West Allis, Wis., is planning a $500,000 expansion program.

BUSINESS ITEMS

Carpenter Steel Co., Cleveland, Ohio, announces that James S. Bailey, Jr., of Cleveland sales staff, will succeed C. A. Heil, retired Nov. 1, as district sales manager.

Clark Controller Co., Cleveland, Ohio, has appointed Charles H. Armstrong assistant district manager of the Michigan area.

Clarostat Mfg. Co., 285-7 North Sixth St., Brooklyn, N. Y., has transferred James Youngblood to Brooklyn as sales engineer in charge of manufacturing accounts and National Defense business.

Cutler-Hammer, Inc., Cincinnati, Ohio, has appointed E. C. Bolton manager of Cincinnati district sales office.

Detroit Power Screwdriver Co. has moved to 2801 West Fort St., Detroit, Mich.

Maurice S. Dessau Co. has moved to 535 Fifth Ave., New York, N. Y. This company is celebrating its hundredth anniversary.

Reed-Prentice Corp., Worcester, Mass., has placed A. R. Morse in charge of the Cleveland, Ohio, office.

Torq Electric Mfg. Co., Cleveland, Ohio, announces the organization of a rush job department to help defense manufacturers get Torq equipment more quickly.

Walker-Turner Co., Inc., Plainfield, N. J., announces that Walter Antener will replace John T. Pheatt, resigned, as advertising manager.

Truscon Steel Co. has sold its property in Milwaukee, Wis., and will operate from Chicago warehouses on account of changes necessitated by defense program and priorities regulations.

Westinghouse X-ray Division, Long Island City, N. Y., will move to the company's radio division plant, Baltimore, Md., about Jan. 1.

Wickes Brothers, Saginaw, Mich., have appointed John R. Cassell Co., Inc., 110 W. 42 St., New York, N. Y., distributors for the Metropolitan New York area.

OBITUARIES

FORD R. LAMB

Ford R. Lamb, 50, executive secretary, past president and charter member, American Society of Tool Engineers, died Oct. 26 in Pinckney, Mich. When in 1932, O. B. Jones conceived a national society of tool engineers, he called on Mr. Lamb for assistance, and with 31 others they organized the A. S. T. E.

A member of the first board of directors, Mr. Lamb was elected president in 1936 and named executive secretary in 1937. In order to give his full time to a life's ambition, he resigned as sales engineer with Consolidated Machine Tool Corporation. Under his management the Society grew from a struggling organization of a few chapters with less than 1,600 members to a strong recognized unit of 42 chapters and 8,000 members.

He conducted a long campaign for the recognition of tool engineering as a profession. With his leadership the A. S. T. E. evolved a curriculum for high schools and discussions were under way with universities planning college courses in tool engineering.

Instrumental in the growth of the A. S. T. E. were the Machine Tool and Progress Exhibitions which he staged in Detroit. These attracted the attention and support of industry. Mr. Lamb never recovered from the strain of directing the show early this year and was finally taken ill August 2.

Previous to joining Consolidated Machine Tool Corporation, he had been treasurer and instructor in tool design at Detroit College of Applied Science and assistant production engineer with the Studebaker Corporation.

William Beye, 60, vice president, United States Steel Corp. of Delaware, died Oct. 27 in Pittsburgh. He was elected vice president of United States Steel Corp. in charge of industrial relations in 1937 and upon organization of United States Steel Corp. of Delaware in 1938 became vice president and general counsel.

L. L. Biche, 53, manager of power transformer sales, General Electric Co., died suddenly Oct. 24 in Pittsfield, Mass. He entered the employ of the company in 1912.

Frank E. Mosher, 71, former secretary, general manager, vice president and treasurer of Cobert Gear Co., Lockport, N. Y., died Oct. 22 at his home in Rochester.

August Peter Munning, 68, president of the Matawan Bank since 1935 and former chairman of the board of directors of Hanson Van Winkle Munning Co., Matawan, N. J., died Oct. 29. In 1888 he became associated with Leonard Izard Co., agents for the original Edison Co., and later joined Cutler Hammer Mfg. Co. of Milwaukee. In 1911 he organized Munning Loeb Co. which in 1927 after two mergers became Hanson Van Winkle Munning Co.

Christian Lauritzen, 76, president and treasurer, Wisconsin Gear & Engineering Co., Inc., Milwaukee, Wis., died Oct. 26. He founded the firm in 1920.

Dean Williams, 68, Milwaukee representative, Erie Forge Co., died Oct. 24 of injuries sustained in a fall. He was formerly purchasing agent, A. O. Smith Corp. and assistant purchasing agent, Allis-Chalmers Mfg. Co.

MEETINGS

American Management Association. Insurance Conference. Statler Hotel, Cleveland, Ohio. Dec. 9-10.

American Management Association. Production Conference, Wm. Penn Hotel, Pittsburgh, Pa., November 19-20.

American Society of Mechanical Engineers. Annual Meeting. Hotel Astor, New York, N. Y. Dec. 1-5.

National Association of Manufacturers. Congress of American Industry, Waldorf Astoria, New York, N. Y., Dec. 1-5.

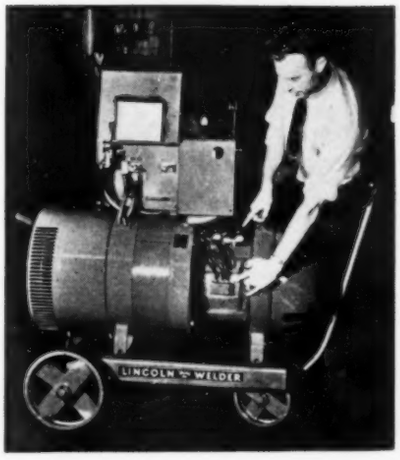
Society for the Advancement of Management. Annual Convention. Commodore Hotel, New York, N. Y. Dec. 4-5.

SHOP EQUIPMENT NEWS

Lincoln Control Device Protects Arc Welders From Excessive Temperature or Current

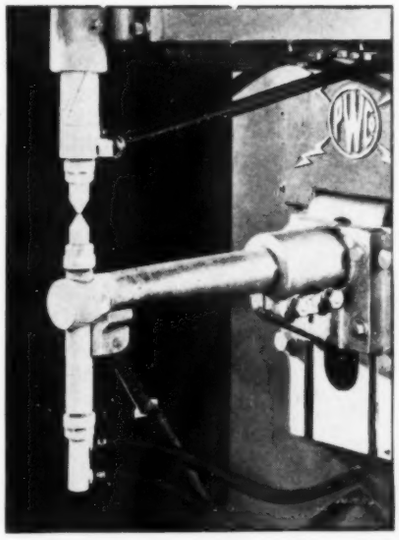
Complete protection against heat or excessive current is provided by the control device for arc welding machines, recently announced by the Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio. Operations of welding machines at maximum capacity for long periods without harm is claimed for this device. Control consists of two current transformers, the primaries of which are connected in series with the motor leads and the secondaries. The latter, mounted directly on the motor lamination, supply power to operate two snap-action thermostats.

Through action of the thermostats, protection is provided against: excessive operating temperatures, excessive current when motor is cold, operation on single phase locked current, overloads due to fuse blowouts, power overloads when rotor is locked, and high input current and motor temperatures. Thermostats automatically reset when the motor returns to a safe operating temperature, or the current is reduced.



A special circuit allows the starter button to be held in after the thermostats have been tripped. Machine rotates with no load and the ventilation produced speeds cooling of the welder.

Refrigeration Increases Number of Spot Welds Obtained Without Dressing Electrode Points



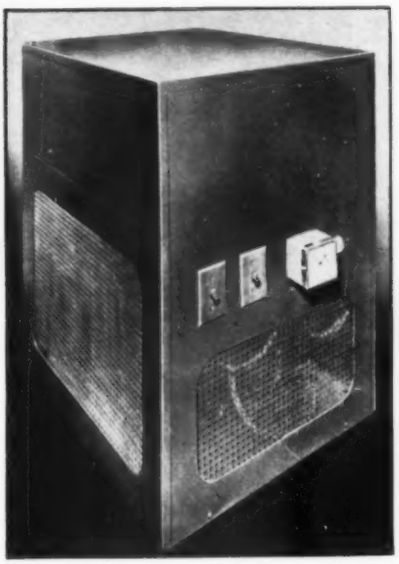
Electrodes covered with frost immediately after a welding run. These have been connected with a refrigerating unit which reduces electrode temperatures so that long welding runs can be performed without requiring point dressing

Four to ten times as many spot welds as usual can be obtained without requiring point dressing by use of the refrigeration unit introduced by Progressive Welder Co., 3001 W. Wacker Drive, Detroit, Mich. Originally intended for Progressive's aluminum and stainless steel welding machines, the refrigerating units are available for other makes. Electrode temperatures are reduced by the device to a point where electrode will be continuously covered with frost. This reduction so increases point life that 10 minute runs at 100 welds per minute are possible.

Primary function is to keep welding point cool at the point of contact. In resistance welding heat is generated at three points: contact between pieces being welded together, contact between upper piece and upper electrode, and contact between lower piece and lower electrode. Only the first is desirable. The other two tend to soften and to permit deformation of electrode tip. This also produces pick-up by alloying the tip with the material being welded. Pick-up is eliminated with refrigeration.

Welding machine settings are actually lower than when operating with water cooling. This is probably due in part to the higher conductivity of copper at lower temperatures. The units can also be used for welding other types of materials besides aluminum and stainless.

Units are available in three sizes for one, two or four welding machines. In most installations it is necessary only

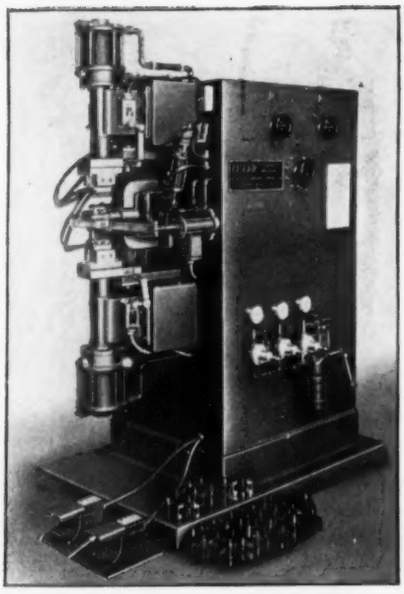


Refrigerating units used for subfreezing resistance welding. Refrigerator unit's inlet and outlet connects to electrode water piping

to disconnect water lines to the electrodes and couple refrigerator unit's inlet and outlet connections to the electrode water piping. Provision is made in each unit for automatic thermostat control, dehydrator, heat exchanger, indicating thermometer and variable pressure pump.

Fins Welded to Steel Tubing By Eisler Air-Operated Machine

Arranged with special jigs and fixtures for welding fins to steel tubing, the No. 600-KED air-operated projection spot welding machine has been placed on the market by the Eisler Engineering Co., Inc., 740 So. 13th St., Newark, N. J. Production rate is approximately 200 finished pieces per hour. No individual jig is needed for loading the work. There are 56 points of heat control. Transformer secondary, welding dies and mandrel are water cooled. Air



operated, the rotating mandrel is fully automatic controlled. Upper and lower welding die and ejector mechanism are also operated from air cylinders. Foot pedals actuate these cylinders which can be individually regulated.

Oscillograph's Blackout Panel Luminous 1 Hour in Darkness

Allen B. DuMont Laboratories, Inc., 2 Main Ave., Passaic, N. J., are equipping their Type 208 oscillograph with a blackout panel which can be used under adverse lighting conditions or in complete darkness when necessary. Steel panel is treated with a non-radio

active luminous paint that retains luminosity for several minutes after exposure to ordinary light. It can be easily observed for at least an hour in total blackness.

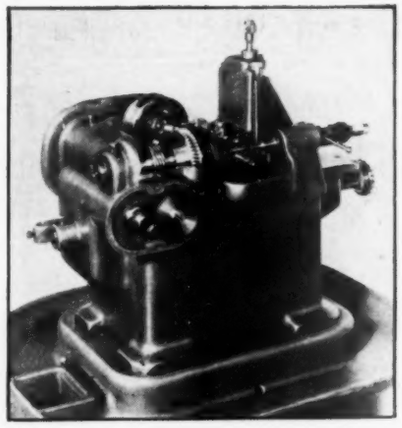
Precision Wheels, Pinions Made on Spur Gear Hobber Copied by Triplex from Swiss Model

Precision wheels and pinions used in watches, clocks and meters, as well as gages and other precision instruments can be cut with the American Micron spur gear hobbing machine, built by the Triplex Machine Tool Co., 125 Barclay St., New York, N. Y. The machine is similar to the Swiss Mikron No. 79. It has a capacity for spur gears and pinions up to 2 in. in diameter, and a maximum cutting length of 1.6 in.

Bronze or steel gear blanks are firmly held on a work arbor which, on one end, fits into a taper hole in the work spindle nose. Pinions are held in a spring collet chuck fitted into the work spindle taper. Outer end of arbor or piece is supported by a tailstock.

Hob spindle is mounted on a vertical slide having micrometer hand feed for positioning to proper depth of cut. Hob spindle revolves through index change gears and through a worm wheel on the work spindle. It is transmitted in the ratio proper for the number of teeth to be generated. Change gears are supplied for one chosen number of teeth between 6 and 390. Additional sets for any number of teeth can be furnished and are easy to mount.

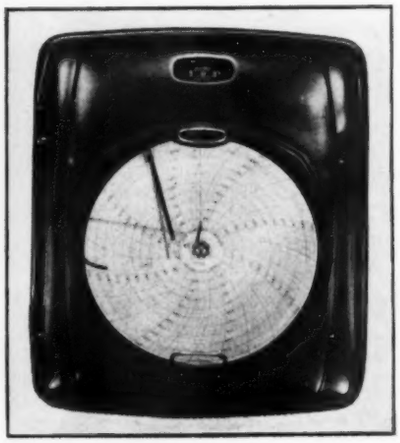
If the tooth shape is of the involute type, one hob will cut all gears of an identical diametral pitch regardless of the number of teeth. For cycloidal teeth, however, an individual hob is required for each number of teeth. Rotation of the work spindle over a pair of helical gears, change gears and a worm drive, is transmitted to the longitudinal feed screw in a ratio appropriate for the feed of the hob. Change gears are supplied for six feeds between 0.004 and 0.030 in. per rev. of the hob.



Hob spindle speeds of 518 r.p.m. for steel and 1,030 r.p.m. for brass are standard. Additional motor pulleys can be furnished, however, to provide different speeds. Drive is furnished by ½ hp. motor mounted inside pedestal and is connected with the spindle over a pair of two-step pulleys and a flat belt. A self-contained pump furnishes constant flow of coolant.

Model 30 Stabilog Controller Provides Closer Regulation

Closer control and greater convenience are featured in the Model 30 controller recently added to the Stabilog line manufactured by The Foxboro Co., Foxboro, Mass. A dual pressure indicator replaces the customary two small gages. All operating adjustments are made from the front, the adjusting mechanism for change of control point, throttling range and reset resistance being accessible when the door is opened. Operating mechanism is protected and concealed behind a removable plate.



Unit construction simplifies replacement of the measuring system, changing the type of control and servicing. Full proportional control of temperature, pressure, liquid level or flow are provided in this instrument. Uniform pneumatic proportional action is adjusted to the smallest value that will result in stabilization following a disturbance of process conditions. The secondary adjustable controlling function is the reset action which establishes stabilization at the desired point of control.

Case is rectangular. When panel is mounted it extends only ¾ in. Door is recessed with hinges flush with surface. Interior illumination can be readily provided.

Large Openings Permit Building Presses Into Production Line

Gooseneck presses of 6 to 25-ton capacity for fast, easy and accurate forcing, stamping, broaching, assembling, and straightening, are offered by the Oilgear Co., 1302A West Spruce St., Milwaukee, Wis. These presses are made with plain platens and with lower platens arranged to receive de-

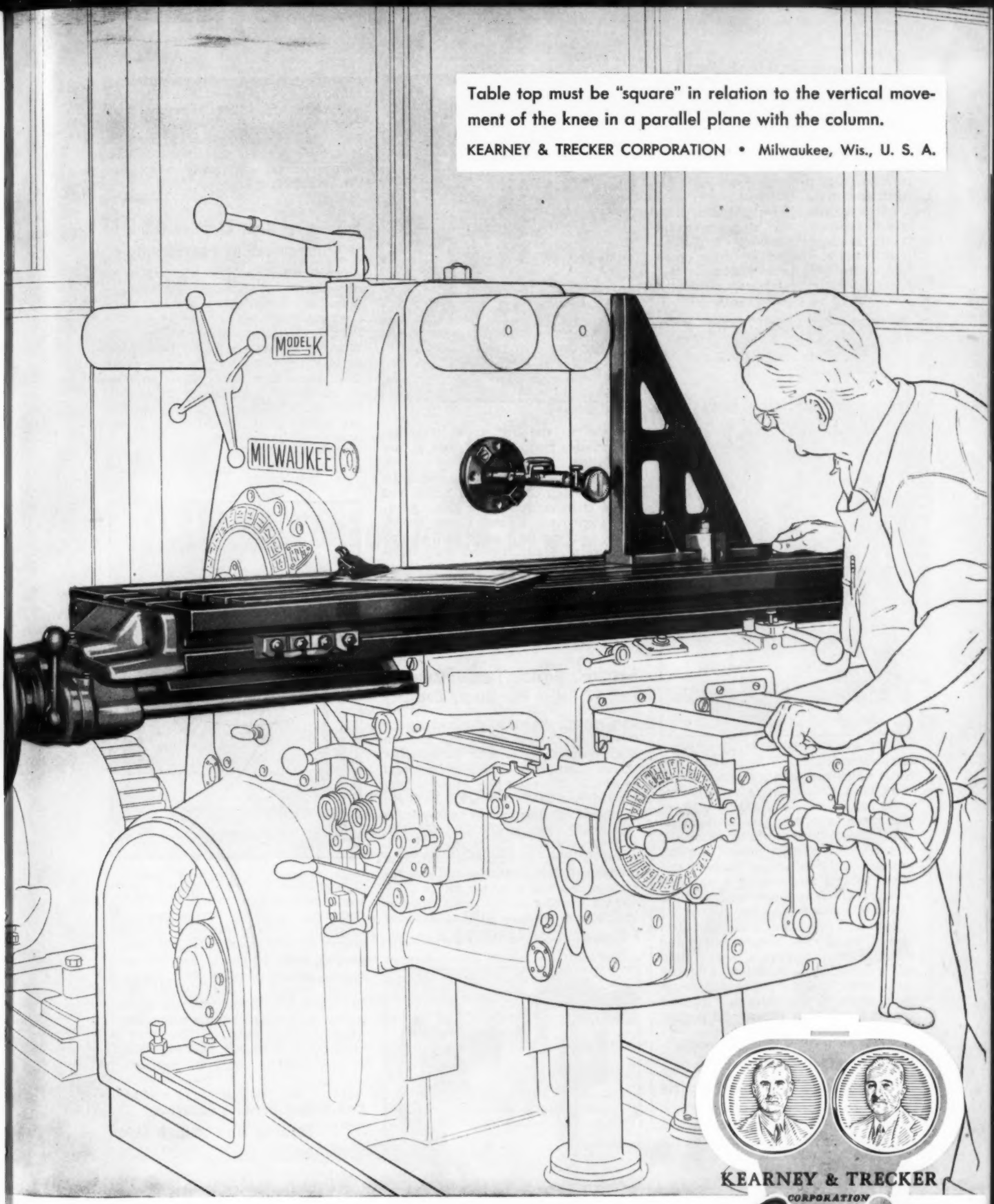


Table top must be "square" in relation to the vertical movement of the knee in a parallel plane with the column.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.

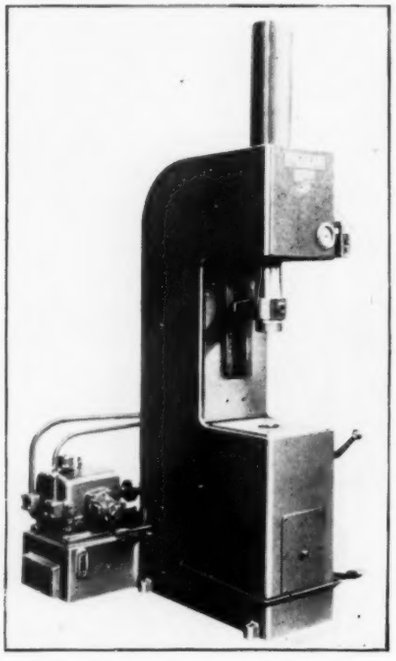
KEARNEY & TRECKER
CORPORATION
Milwaukee
MILLING MACHINES

Milwaukee MILLING MACHINES

tachable tables or fixtures. Large daylights and openings on three sides permit building into production lines for handling small, large or long parts.

Standard controls include a hand lever and foot pedal mechanism for regulating variable ram speed in either direction, the pressure applied to the work and the distance of ram travel; a follow-up hand lever providing high speed approach for a pre-set ram travel, sensitive follow-up at a speed and distance selected and high speed ram return to a pre-set position.

Special controls also are available; a



semi-automatic hand lever and foot pedal which causes ram to move downward at a pre-set speed to a pre-set point and return automatically at high speed to starting position; a semi-automatic control providing automatic ram reversal when a pre-set working pressure and tonnage is reached, and pump control maintaining a specified pressure on ram indefinitely without excessive heating or power loss.

Each unit consists of a rigid all-steel welded frame with integral pump and motor reservoir in base, a large ground and polished ram guided in a bronze liner, built in direct-reading pressure gage, molded ram packing, inclosed control mechanism, pumps and motors.

Delta Manufactures Drill Press In Slow and High Speed Models

Slow and high speed models of a low-cost power feed drill press have been announced by the Delta Mfg. Co., 620 E. Vienna Ave., Milwaukee, Wis. Power feed of the units, which include single and multiple spindle 17 in. machines, operates directly off the bottom drive of the motor instead of spindle. Feeds from 0.001 to 0.016 in. per revolution of spindle are obtained in the slow speed

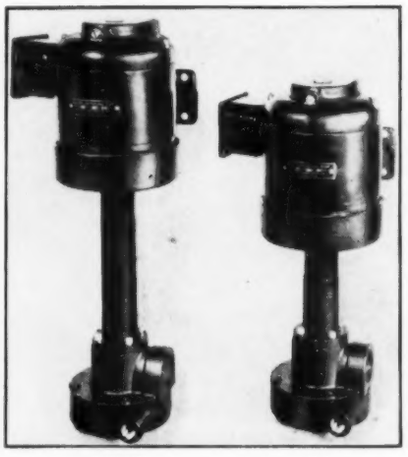
presses. In the high-speed machines feeds range from 0.005 to 0.009 in. per revolution.

A special belt tension release with the two four-step cone pulleys make feed speed changes quick and safe. Accurate stopping is assured by the bronze gear and specially hardened ground steel worm. Quick traverse from starting to work is done by hand. A safety lock prevents damage to drill press when power feed is disengaged. Either table raising or head raising mechanisms are furnished.

Eastern's Coolant Pumps Have 17 Gallon Per Minute Capacity

Two coolant pumps of compact design have been announced by the Eastern Engineering Co., 45 Fox Street, New Haven, Conn. One is 19¾ in. high and weighs 35 lb., while the other is 16¾ in. high and 30 lb. in weight. Both are ⅛ hp., 1,725 r.p.m. semi-inclosed for use on 110 volts, or 220 volts, 60 cycle, 1 phase current. Outlet takes ½ in. standard pipe. Pump has a maximum capacity of 17 gal. per min. and a maximum pressure of 6 lb. per sq. in.

Open impeller allows small chips or grit to pass through without harming pump. There is no stuffing box to leak,

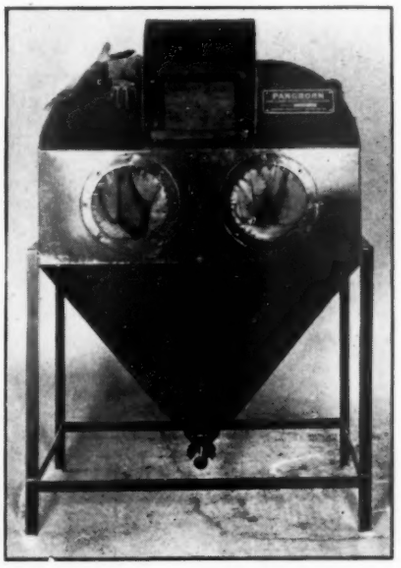


consume power or require adjustment. Pump is constructed of cast iron and so designed that there is no metal to metal contact below the liquid level. Pump inlet located above the impeller is tapped for 1¼ in. standard pipe. Flange, bracket or sump mountings are furnished.

Economical Blast Cleaning Cabinet Announced by Pangborn Corp.

A small blast cleaning unit which is economical for plants having a minimum or occasional need for blast cleaning, has been introduced by the Pangborn Corp., Hagerstown, Md. Work up to 10x12x30 in. can be cleaned by sand or steel abrasives at air pressures above 20 lb. A ⅜ in. air jet with ½ in. nozzle is ordinarily furnished. However, if there is insufficient air for this size, a ⅜ in. air jet and a ⅜ in. nozzle will be supplied.

Work openings, 12x13 in., are located at either end of the blast cabinet.



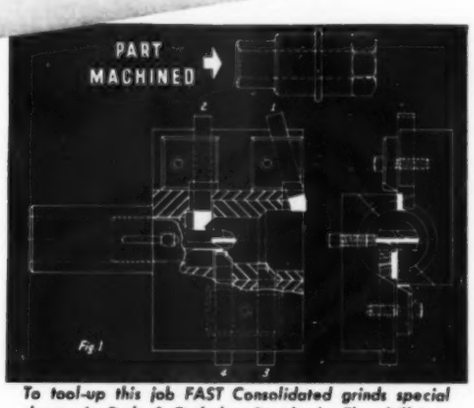
Hinged heavy-rubber sheets seal openings abrasive tight when blast is in operation. A vision window protected by sliding screen is 10x8 in. The rubber sleeves for operator's arms grip tightly around wrists of gloves. Movable gun nozzle permits blasting over the full grated area at correct distance from the work. A push and pull rod, located within easy reach of operator's right hand, controls abrasive. The unit is 24 in. wide, 45 in. long and 68 in. high. It weighs 290 lb.

Coil Winder Permits Accurate Leveling Wire at High Speed

A simple fiber guide block on the No. 2 universal coil winder, produced by the Globe Tool and Engineering Co., 436 Davis Ave., Dayton, Ohio, permits accurate leveling of wire on the winding spindle at speeds up to 4,000 r.p.m. Operator is in full control of the winder

FOR FASTER "Tool-Ups"

Grind your own special shapes from CARBOLOY standard-stock tools



To tool-up this job FAST Consolidated grinds special shapes in Style 1 Carboloy Standards. The drill is a standard Carboloy Masonry Drill.

93% of Consolidated Brass Co's Carboloy Requirements —are adapted—in their crib—from this one style of Standard Tool

To get the fastest possible service on special carbide tools, many leading plants today are maintaining nominal stocks of Carboloy Standard Tools and grinding these to meet special requirements whenever necessary.

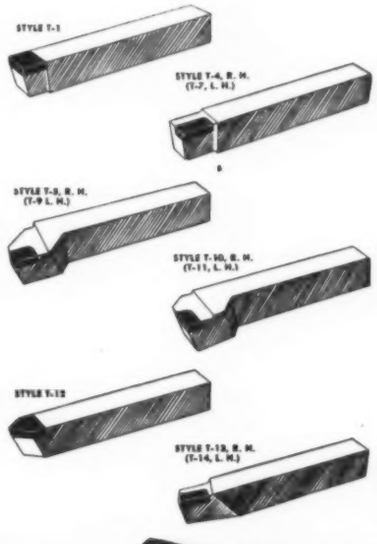
Carboloy Standard Tools are manufactured by Carboloy in "mass production" quantities and are always available faster than specially shaped tools. Produced in 10 styles, Carboloy standards can be quickly reground in your tool room for use on 60%-80% of all turning, facing, boring operations on steel, cast iron, non-ferrous metals and non-metallics.

At Consolidated Brass Co., Detroit, for example, a survey showed that one style of "Standard" (Style 1) in just two sizes, was adaptable to 93% of their total Carboloy tool requirements. These are stocked by them . . . ready, at a moment's notice, to be ground to special shapes desired, in Consolidated's tool room. As a result, there are no delays awaiting special tools. Jobs are tooled up FAST, whenever needed.

This may be the answer to faster tool-ups on your jobs. Write for Catalog GT-129.

CARBOLOY COMPANY, INC., 11149 E. 8 MILE ROAD, DETROIT, MICH.
Chicago · Cleveland · Los Angeles · Newark · Philadelphia · Pittsburgh · Worcester, Mass.
Canadian Distributor: Canadian General Electric Co., Ltd., Toronto, Canada

Use these Carboloy Standard Tools for 60%-80% of all turning, boring, facing jobs.



CARBOLOY STANDARD TOOLS & TIPS

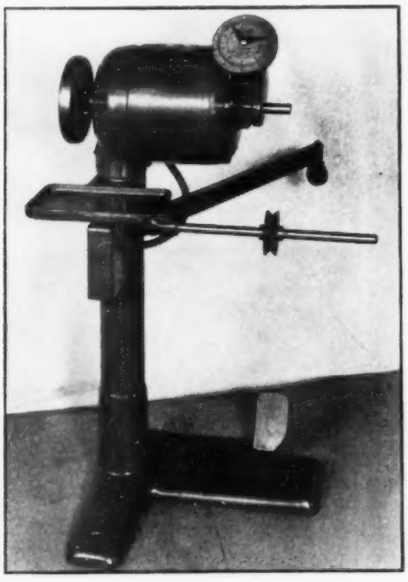
"You ALWAYS Get Standards FASTER Than 'Specials'"

CATALOG GT-129

SEND FOR FREE CATALOG

through a foot pedal, which operates the quick acting brake, mercury starting and stopping switch, and motor throttle. This synchronization facilitates rapid but smooth acceleration and immediate deceleration.

The 10,000 turn counter subtracts when turns are removed as in the case of an overrun. When winding is completed, the counter is simply and

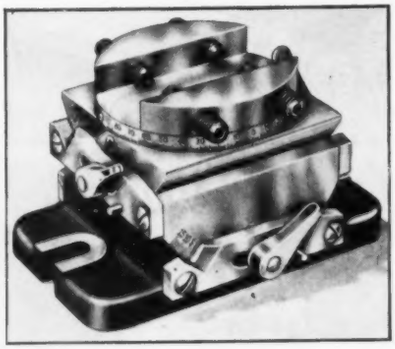


quickly reset to zero. The model for winding the No. 25 to No. 40 copper wire or equivalent has a speed range from 0 to 6,000 r.p.m. Back-geared models are provided for high torque required in winding larger wires. Speed ranges are proportionately reduced. Special combination backgear and direct drive models are available.

Hammond Markets Tool Vise Permitting Adjustment to Any Angle

An any-angle tool vise, designed for use when grinding chip breaker grooves into the tips of carbide tools, is being marketed by Hammond Machinery Builders, Inc., 1618 Douglas Ave., Kalamazoo, Mich. Vise is mounted on a lug base which is easily affixed to a machine table. Vise is constructed on a double-cradle principle permitting adjustment of angles in three planes.

Two closely machined steel blocks,



rounded on the bottom, are cradled into each other at right angles. They are solidly locked together by tightening cam locks at the ends of the blocks. Mounted atop these blocks is a flat circular piece which swivels 90 deg. from center of any of the four sides of the block immediately below. This piece carries the vise jaws, holding tools firmly by Allen screws.

The closely fitting steel blocks which may be tightly locked together prohibit vibration or deflection. Each tilts 15 deg. either way from horizontal, and this adjustment combined with 360 deg. selectivity of the circular piece provides almost any angle desired.

Dust From Grinding, Polishing Collected by Torit Separator

Separators for collecting dust from grinding and polishing wheels are being marketed by the Torit Mfg. Co., 230 Walnut St., St. Paul, Minn. They are used with or without filter bag col-

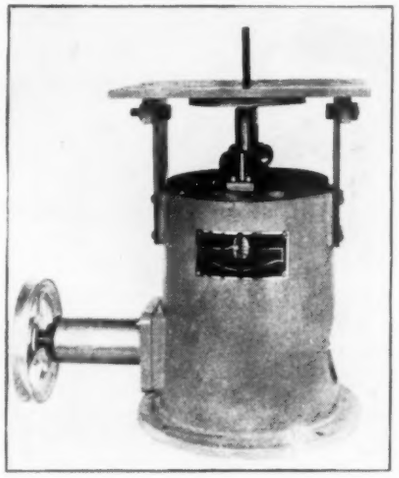
lectors. Through centrifugal action 75 to 95 percent of dust entering separator falls into the bottom chamber. A small amount that does not separate is exhausted through a center pipe on top of unit or is caught in filter bag where this is used. Suction is created by a ½ hp., 3450 r.p.m. end-mounted motor.

Circle Measurements Read Quickly With Wolfe Meter

For instantaneous readings in fractions of an inch of diameters and circumferences of circles with diameters up to 72 in., the Interstate Sales Co., 1123 Broadway, New York, N. Y., has developed the Wolfe circle meter. Small circles indicate diameters, the large ones circumferences. Readings are taken by using circles with the same color numerals.

Steel Table on Bench-type Filer Tilts to Either Side

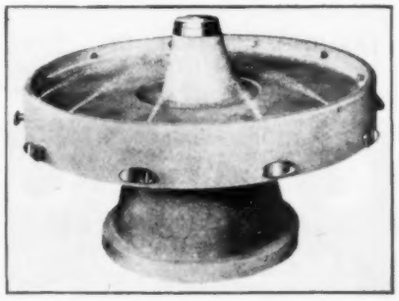
A bench-type machine for filing dies, gages, templets, irregular shaped holes and slots, has been designed by Engi-



neering and Sales Co., 1821 Cleveland St., Hollywood, Fla. Table, made of steel plate, 8x8¾ in., can be tilted to either side. Ball bearing guides for the vertical motion of spindle at the point of greatest pressure provide a substantial support and eliminate wear. Lower end of spindle has a bronze bushing. Horizontal shaft is provided with tapered roller bearings.

Washfountain Sprays Located On Outer Rim Prevent Splashing

Industrial group washfountains with spray head located on the bowl rim instead of center post to prevent splashing have been announced by the Standard Washroom Equipment Co., 1000 So. Niagara St., Saginaw, Mich. They are available in 36 or 54 in. diameters and have ten individual spray heads. Spray is controlled either by leg control (pressure by leg on metal pad directly beneath spray head), individual control by turning spray head.



Help

KEEP TOOLS SHARPER...LONGER

with **SUNOCO** EMULSIFYING CUTTING OIL

SET A HIGHER P-Q* WITH MORE PIECES PER TOOL GRIND

Now more than ever it's important that you set a higher P-Q* (Production Quota) for your small tools . . . that they stand up and deliver under fast, heavy cuts.

"Down time" for resharpening and resetting is waste time . . . lost production! That's why leaders in the metal working field today are relying on SUNOCO Emulsifying Cutting Oil to help reduce "down time" and meet defense production schedules.

SUNOCO's remarkably high lubricating and heat absorbing qualities prolong tool life. It rapidly carries away heat . . . prevents chips from seizing . . . permits faster stock removal. With SUNOCO tools cut cleanly, evenly . . . maintain close tolerances and fine finish. The result . . . fewer rejects.

Follow the leaders! Help get more pieces per tool grind with SUNOCO and pave the way for a higher P-Q*. A SUN Cutting Oil Engineer will be glad to arrange a test run in your own plant . . . under your own operating conditions. Write to

SUN OIL COMPANY · PHILADELPHIA

Sponsors of the Sunoco News Voice of the Air—Lowell Thomas

PERFORMANCE DATA

OPERATION: 4 cuts 2" to 5/8" diameter Multiple Cutter Turner.

MACHINE: Warner & Swasey No. 5 Universal Turret Lathe.

MATERIAL: S.A.E. 1315 steel.

CUTTING SPEED: 103 S.F.P.M.

CUTTING LUBRICANT: 1 part Sunoco to 20 parts water.

OPERATOR + MACHINE + RIGHT CUTTING OIL = P-Q* PRODUCTION QUOTA

SUN OILS

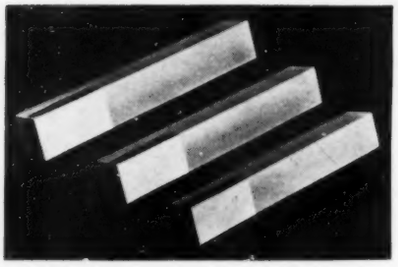
PETROLEUM PRODUCTS FOR ALL INDUSTRIES

Copyright 1941 by Sun Oil Company

or single control of all sprayheads by one valve. Water in all models is used only after passing through automatic temperature control valve. Equipment for powdered, liquid or bar soap is available for attachment.

High Cutting Speeds Permitted With Tantung Blades, Tools

Milling cutter blades and all-purpose tools are being manufactured from Tantung "G", a non-ferrous tool alloy containing tantalum carbide, by the Vascoloy-Ramet Corp., North Chicago, Ill. High cutting speeds are permitted with uninterrupted cuts, heavy roughing cuts, or cuts through scale and hard spots. Material which can be machined includes all kinds of rolled, forged or cast steel, iron, aluminum, brass and copper. Primary function is to increase output of operations through higher cutting speeds and longer runs per tool grind. The tantalum carbide imparts a lubricating action to resist chip wear and cratering.



Lubricator Operates Regardless Of Position; One Valve Required

A sight-feed lubricator for air-driven equipment, which operates successfully regardless of its position in the line, has been developed by the Roto Co., 145 Sussex Ave., Newark, N. J. It has no baffle, thus can be turned in any position convenient for visibility. Only a single regulating valve is required instead of the three separate valves used on previous types. Oil is added by removing a screw plug at the top of the lubricator. Installation is made in an ordinary tee in the air line. Lubricators are made in ½ pint and quart sizes, and can be regulated to drop as few as 5 drops of oil per min.

Granell Machine Performs Cylindrical, Plug, Surface Grinding

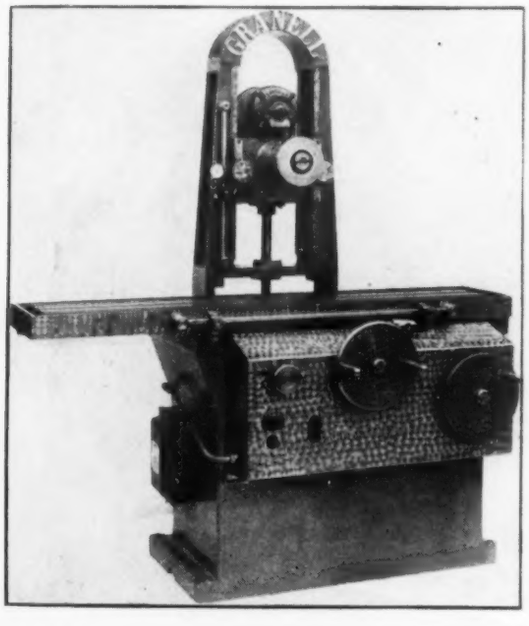
Cylindrical and plug grinding as well as surface grinding can be performed with the automatic feed grinder produced by G. P. Granell & Son, 292 Geary Ave., Toronto, Canada. Table is 68 in. long by 12 in. wide and has a hand travel of 36 in. Automatic travel is 34 in. and cross feed 10 in. Table is equipped with a worm-rack drive.

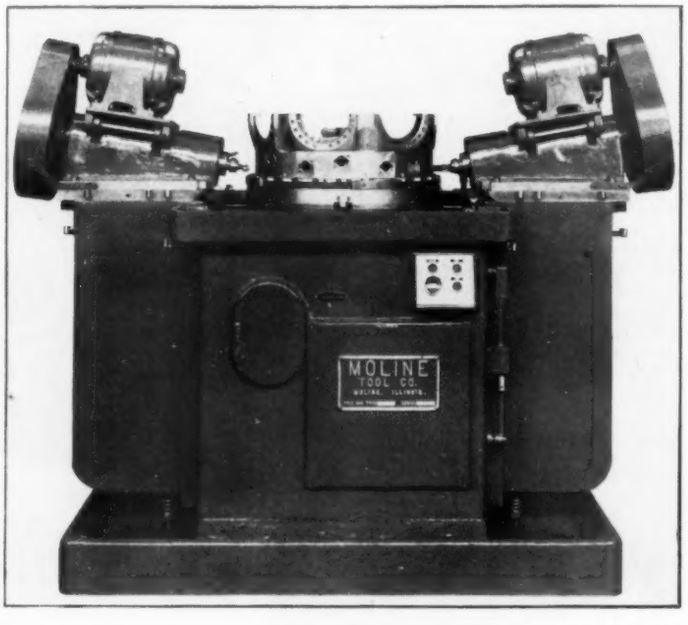
Work 34x10x14 in. can be taken on the working surface, which is 24 in.x10 in. and has 3 T slots ⅝ in. wide. Spindle runs clockwise in a phosphor bronze front box at speeds of 3,500 r.p.m. Straight wheels up to 1 in. thick, 10 in. diameter with a 1½ in. hole can be taken. A vacuum motor is attached for the suction of abrasive dust.

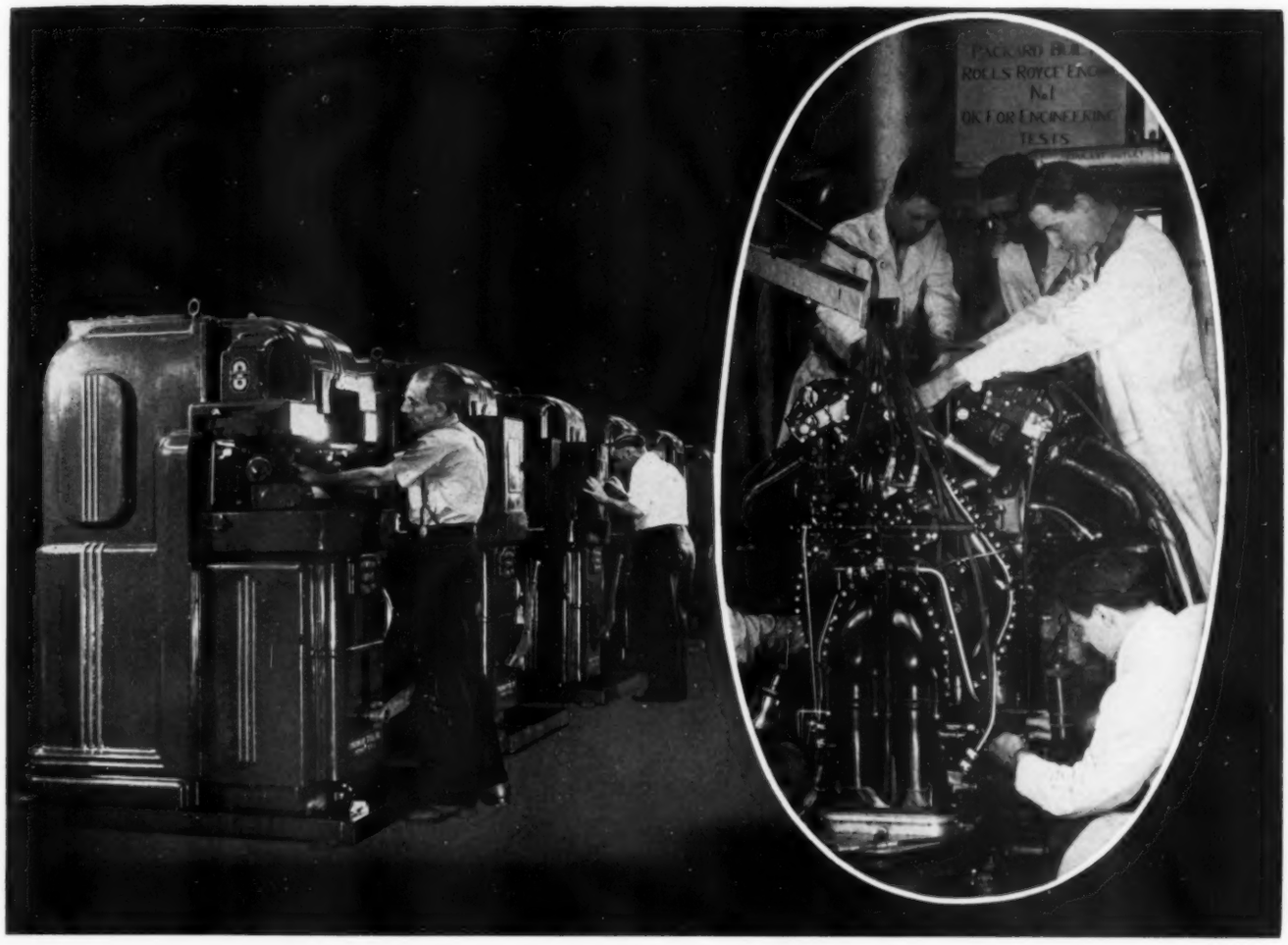
Reversal of table is controlled by adjustable dogs operating against a reversing lever. Transverse table feed is automatic with a range of 0.006 to 0.110 in. per reverse of the table. Feed is controlled by a hand wheel graduated to 0.001 in. An automatic knock-off lever provides instant stopping and starting of both longitudinal and transverse table movements. The machine occupies floor space 90x34 in., and it weighs 4,600 lb. without motor or crankshaft.

Miller Finishes Two Bolt Holes On Radial Crankcase at One Time

Spherical clearances in the ends of bolt holes in crank case sections of radial type aircraft engines are milled with the No. 23 machine, designed and built by the Moline Tool Co., Moline, Ill. Crankcase section is clamped onto the round indexing table. Operator then starts the cycle and holes are milled two at a time. Automatic indexing moves crankcase so that each pair of holes is brought into position for milling. Electrical and mechanical interlocking prevents the cutters from entering work except at desired point.







Packard Shaves *and* Merlin Ticks

SWEETEST music to a fighter pilot's ear just before the take-off is the smooth ticking-over of his warming engine that signals him that every vital part of his engine is "Right."

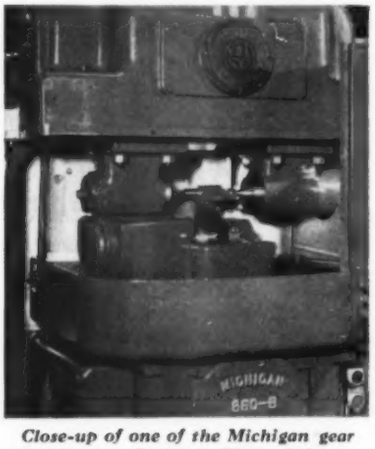
When, on August 2nd, Packard's first Rolls-Royce "Merlin" was started from London by radio, its sweet ticking was music to many ears. Music to the pilots who will soon be flying behind them by the hundreds and thousands.

Music to Packard's Design and Tool Engineers, who in ten short months had magically transformed a bundle from Britain—2000 left-handed blueprints—into an engine built by American mass production methods on American machines to the closest of tolerances.

That ticking brought to within a short step the time when identical "Merlins" by the hundreds and thousands will swing off the end of Packard's new line—smoothly ticking Merlins equipped with gears shaved on a battery of Michigan rotary gear finishers to match the rigid specifications of Packard's new aircraft engine.

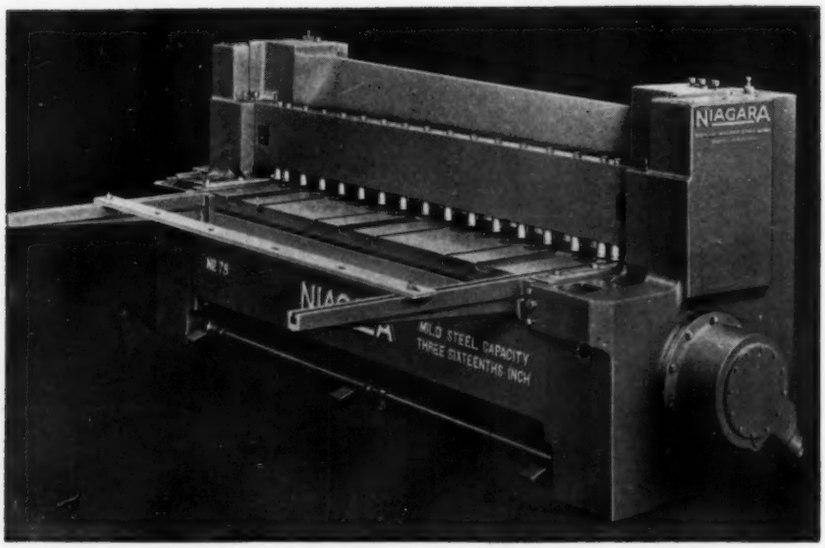
Above, left: Part of the battery of Michigan 860-B rotary gear shavers used at Packard for finishing gears for the new Rolls-Royce 'Merlins'.

Right: Packard's first Rolls-Royce 'Merlin' being readied for its first official test.



Close-up of one of the Michigan gear finishers at Packard. These finishers employ the famed Michigan crossed axis shaving principle.

MICHIGAN TOOL COMPANY 7171 E. McNICHOLS ROAD DETROIT, MICHIGAN



Shears Cut 4 to 12 ft. Lengths At Rate of 60 Strokes Per Minute

Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., has added a Series No. 7 line of power squaring shears built in 4 to 12 ft. cutting lengths. Capacities of these shears are from ¼ in. to 10 gage. Machines can be operated at a speed of 60 strokes per minute with convenient, safe handling of stock and cut-off material.

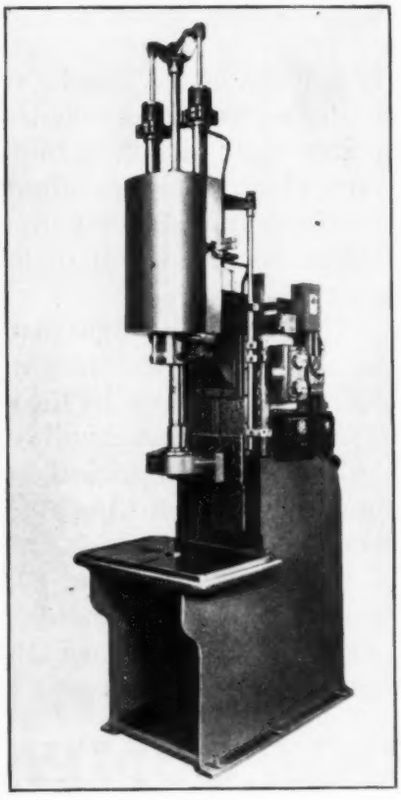
These shears are of underdrive design with drive including flywheel, gearing, clutch, eccentrics and connections completely inclosed and operating in a bath of oil. Self-measuring, ball bearing parallel back gage adjustable to increments of 1/128 in. is standard equipment. Front gage with front brackets, side and bevel gages are furnished.

Lid-Lifter on Cooling Unit Improved by Leeds & Northrup

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa., have incorporated an improved lid-lifter on the Homocarb cooling unit used in connection with Homocarb furnace equipment for carburizing. Lifter consists of a lever acting on a roller fulcrum which gives an easy, horizontal lift.

Revolving Bushing Provides Rigidity for Tools on Borers

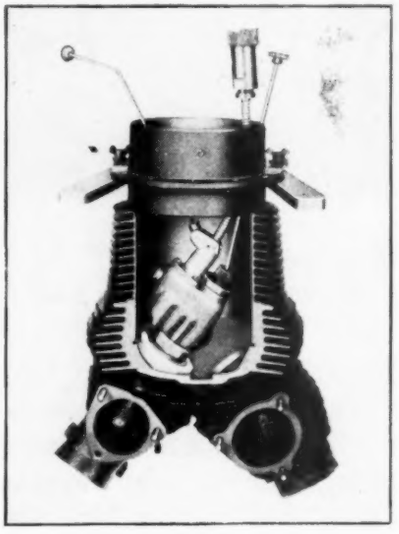
The Model 2V Carbideborer has been remodeled by the Giern & Anholtt Tool Co., 1312 Mt. Elliott Ave., Detroit, Mich., with a heavier column, a one-piece spindle saddle, electrical controlled dwell and electric switch mechanism. Most important feature of the machine is the revolving bushing, which is located at all times immediately above the work. Boring tool is fitted into the bushing to provide the necessary rigidity for high speed boring with tungsten carbide. Another bushing can be mounted in the table for guiding front pilot in deep boring.



Dwell makes it possible to approach holders or face bottoms. All drives are V-belts. Hydraulic spindle feed is 18 in. The 32½ in. spindle is driven at speeds from 380 to 1,400 r.p.m. by a 3 hp. motor. Boring capacity is ¾ to 3 in. in diameter. Clearance from spindle to column is 9⅝ in. and to table, from 29½ in. in the up position to 11½ in. in the down position. A 1½ hp. motor provides power for the hydraulic feed. Motors are 220 or 440 volts, 60 cycle, 3 phase.

Grinder Finishes Valve Seats In Five Minutes; No Tearing

With the wet type valve seat grinder, manufactured by the Hall Mfg. Co., Toledo, Ohio, bronze, stainless steel, stellite and other alloy seats can be ground to a precision finish in an average of 5 minutes per seat. Reaming or fly-cutting is eliminated.

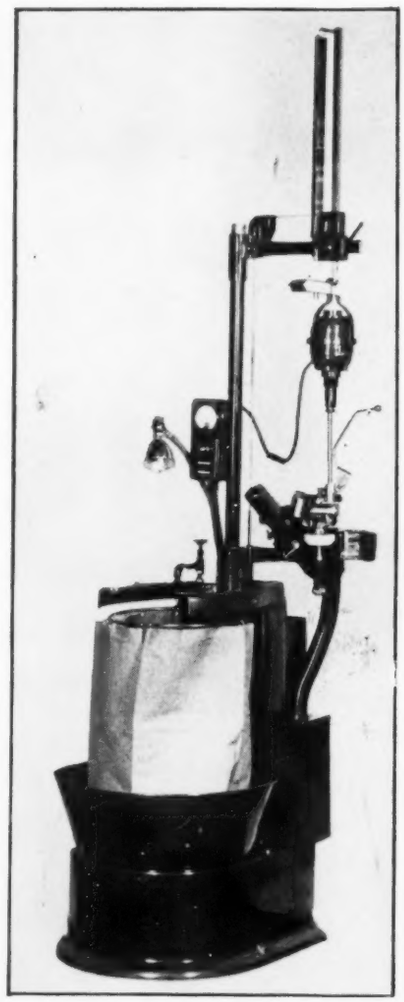


Grinding wheel shown in position for finishing valve seat. Wheel speed is 10,500 r.p.m.

Wet grinding minimizes wheel loading and prevents tearing or surface burning of the seat. Grinding wheel speed is 10,500 r.p.m. as it travels eccentrically around the pilot at 22 r.p.m. Point contact of wheel with the seat is set for finest finish with a minimum of wheel loading and breakage. Fast cutting, in frequent need for wheel dressing and extreme precision enable the operator to produce better valve seats in less time.

In blind grinding, an ammeter swings to right when the high spots are being ground, then drops to idling load and shows constant minimum

A TRUE EYE FOR BRASS. In every department at Revere Copper and Brass Incorporated you will find men who have a "knack" for brass. Men like Peter Gura, for instance, who has been with Revere for thirty-five years—a man whose eye can tell to a hair when a brass shape is out of true, and who can set it straight as a plumb line with a practiced twist of his hands. In operations such as this, which would baffle a machine, Revere sees an opportunity to put an extra ingredient—the *human touch*—into copper and copper-base alloys. That is one of the many reasons why Revere materials are so trustworthy in strengthening America's defense, and why the end of the emergency will find Revere so well prepared for the advancing needs of industry. Revere Copper and Brass Incorporated, 230 Park Avenue, New York.

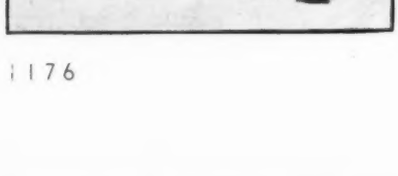


Valve seats are ground by this machine in 5 minutes

reading when high spots have been removed. A diamond dresser, completely inclosed against abrasive, is graduated for dressing grinding wheels of 15, 20, 30, 45, 60, 70 and 90 deg. An inspection light with reflector on gooseneck is provided. Splash curtain prevents loss of coolant due to splashing and protects operator's clothing.

Line of Carbide Tipped Tools Includes 6 Styles, 46 Sizes

A line of standard stock tools comprising 6 styles and 46 sizes have been announced by the Tungsten Carbide Tool Co., 7171 E. McNichols Rd., Detroit, Mich. All tools are carbide tipped, have diamond ground edges and are ready for immediate use. Suitable for cast iron, non-ferrous metals and steel, they are designed to cover most turning, boring and facing requirements. They may be readily converted into special shapes by simple grinding operations at a saving over the purchase of "special" tools. To aid identification, styles and sizes suitable for cast iron and non-ferrous metals are furnished with gray shanks, while those for steel have black shanks.



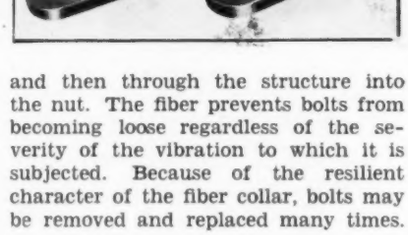
Toggle Clamp Exerts 500 Lb. Pressure; Used on Aircraft

Pressure in excess of 500 lb. is obtained with the Model No. 830 Midget Toggle Clamp announced by Knu-Vise, Inc., 16891 Hamilton Ave., Detroit, Mich.

Clamps, which include spindle and rubber cap, are but 4 in. long by 1½ in. high. Because of the small size and great holding strength, it is adaptable to aircraft work.

Fiber Locking Collar Prevents Loosening of Bolts by Vibration

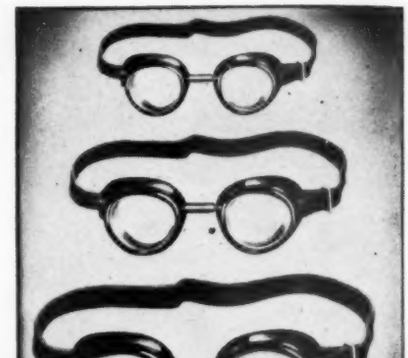
Stationary nuts for blind mounting applications on general industrial equipment are being offered by Elastic Stop Nut Corp., 2332 Vauxhall Rd., Union, N. J. These nuts are offered in a wide range of size, material and threads. An integral part of each is a fiber locking collar. Bolts which are inserted from the outside, pass first through plate



and then through the structure into the nut. The fiber prevents bolts from becoming loose regardless of the severity of the vibration to which it is subjected. Because of the resilient character of the fiber collar, bolts may be removed and replaced many times.

Composition Frame Safety Goggles Furnished in 3 Sizes; 700 Vents

A line of composition frame safety goggles in three sizes has been announced by Kimball Safety Products Co., 7314 Wade Park Ave., Cleveland, Ohio. These "FaceFitt" goggles are drop-eye shaped which matches the



contour of the eye socket. They are light weight and ventilated top and bottom with more than 700 holes. Sizes available are 42x45 mm., 45x48mm., and 48x51 mm.

Many Small Drawings Printed At Once With Photocopying Unit

Large single drawings, 36×88 in., or many small drawings can be printed at once with the contact photocopying equipment recently completed by the Hunter Electro-Copyist, Inc., Syracuse, N. Y. The unit employs photocopying processes involving a horiontal bank

of white and amber lamps beneath a ground glass on which the sensitized paper and matter to be copied are held. Paper and copy material are held firmly in contact by high vacuum created by a motor-driven pump.

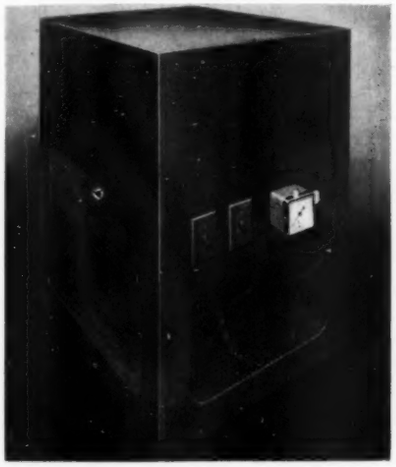
Circular Surface Plate Has 7 Supports, Weighs 6,700 Lb.

A circular surface plate, 96 in. in diameter, for use in the as cast condition has been developed by the Fulton Foundry & Machine Co., E. 75th St.

ICE-COLD WELDING NOW POSSIBLE

Speed Welding of Aluminum for Defense Products

DETROIT.—Even faster production-welding of aluminum than already made possible by Progressive Welder Company's 3-Phase aluminum welder is now forecast as the result of the adaptation of "refrigeration" to this machine. Continuous runs without point cleaning for 10 minutes at 100 welds a minute are no longer unusual as the result of the new development, compared with the usual 40 or 50 spots between point dressings.



Progressive Makes New Units Generally Available

DETROIT.—In view of their potential importance in defense production, Progressive Welder Company has announced that its new refrigerating units will not be limited to use with Progressive welding equipment but may be used with other makes of welding machines and for other materials besides aluminum.

Installation is said to be extremely simple since the units are self-contained and need merely be coupled to the normal cooling water connections of the electrodes.

The units are available in a range of sizes permitting the use of one unit to serve as many as four welding machines, if desired.

Refrigerating Units to Be Patented

DETROIT.—Patent applications have been filed by Progressive Welder Company on its new refrigerating unit for welders.

Refrigerating Units for Welders Announced

DETROIT.—Welding, at tip temperatures so low that electrodes are continuously covered with frost is the newest and "hottest" thing in welding, particularly the welding of aluminum.

Developed by Progressive Welder Company, of 3050 E. Outer Drive, the new units are said to make possible the welding of four to ten times as many consecutive spots without necessity of shutting the machine down for "dressing" the points.

Unretouched photo of tips taken immediately after a welding run.

Complete Information Offered

DETROIT.—Complete information on the new refrigerating units will be supplied on inquiry from:

PROGRESSIVE WELDER CO.
3050 E. Outer Drive, Detroit

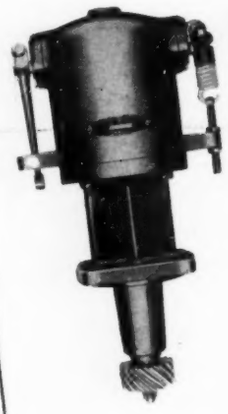
In spite of the high temperatures required to perform the actual weld itself, electrodes are covered with frost almost to the very tip—even when welding aluminum at 100 welds a minute with the Progressive 3-Phase Aluminum Welder.

In operation the frost line moves up and down the electrode from the tip a mere 5/16 of an inch, every time a weld is made at this speed.

Progressive's 3-phase short wave aluminum welder (refrigerating unit is behind the welder.)

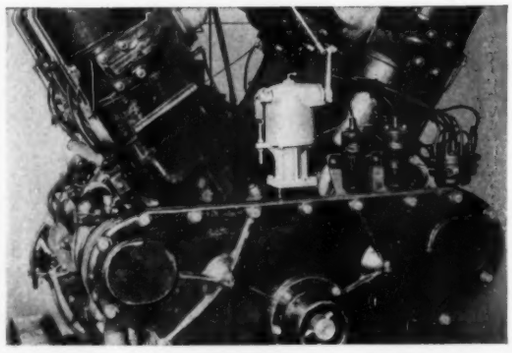
Refrigeration Unit Cuts Tip Pick-up

DETROIT.—Development of a commercial refrigeration unit for resistance spot welders is believed here to be the answer to tip "pick-up," especially in welding of aluminum, stainless, etc. The low temperature of the welding electrodes virtually eliminates the cause of tip pick-up, or partial "welding" of the tip to the material being welded.

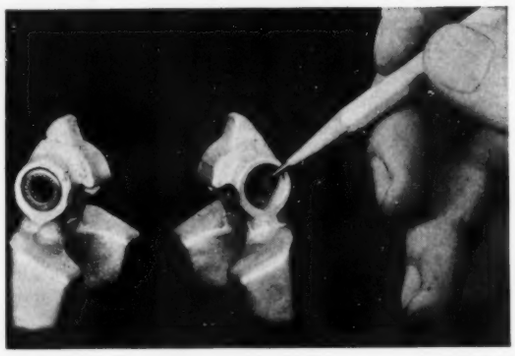


NEEDLE BEARINGS SIMPLIFY DESIGN, CUT FRICTION FOR PIERCE GOVERNOR

"FRICTION LAG IS BEING 'BLITZED' by Torrington Needle Bearings in many Pierce Governors where the critical demands of defense needs require friction-free operation," says Maynard L. Heacox, of the Pierce Governor Company. Shown at right is an installation on a LeRoi gasoline engine. Other advantages are low cost, easy installation and efficient lubrication.



"TO MEET RIGID WEIGHT AND SPACE limitations, Needle Bearings are used on the flyball weight pivots," adds Mr. Heacox. Here these compact bearings occupy no more space than ordinary bushings, yet substantially reduce oscillation friction. And they are used also on valve and rocker shafts where they provide an exceptionally high radial load capacity.



Perhaps a small, lightweight, anti-friction bearing can give *your* product valuable advantages. Remember that Torrington Needle Bearings take no more space than bushings, yet provide exceptionally high load capacity with a minimum of wear and attention. Write for Catalog No. 105 and find out the complete details about this compact, low-cost bearing. Our Engineering Department will be glad to answer any questions. For information on Needle Bearings to be used in heavier service, write our associate, Bantam Bearings Corporation, South Bend, Indiana, for Booklet 104X.

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Makers of Needle and Ball Bearings

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and Morgan Ave., Cleveland, Ohio. Spacing of the ribs was proportioned so that all are of nearly uniform length. Top is comparatively thin to maintain a good proportion between the metal sections of the ribbing and the top. There are six outside and one center support for the 6,700 lb. plate. In machining all supports were faced off and the outer edge turned. Top was finished with only one roughing and one finishing cut.

TRADE PUBLICATIONS

AIR POWERED RIVETING Bulletin No. RP1 describing an air-powered rivitor has been published by the Tomkins-Johnson Co., Jackson, Mich.

BLAST CLEANING Abrasive blasting with a simple mechanical unit utilizing controlled centrifugal force instead of compressed air is described in a 16-page pamphlet published by American Foundry Equipment Co., 555 S. Byrkit St., Mishawaka, Ind.

CEMENTED CARBIDE Applications of cemented carbide to fast wearing machine parts are illustrated in a 12-page booklet published by the Carboloy Co. Inc., East Eight Mile Road, Detroit, Mich.

GAS GENERATOR Generators for making gas from No. 1 fuel oil are described by the American Gasifier Co., Wallingford, Conn., in an eight-page booklet. Gas is used to fire burners in heat-treating furnaces.

GAS HEATING Heat-treating, annealing, melting and finishing metal products with radiant gas heat is outlined in a booklet published by the Selas Co., Erie Ave. and D St., Philadelphia, Pa.

GUN INSPECTORS Borescopes for inspection of gun barrels are briefly described in a four-page leaflet put out by the Lenox Instrument Co., 2010 Chancellor St., Philadelphia, Pa.

INDUCTION HEATING A folder on induction heating generators for surface hardening, brazing, melting, annealing, forging and heat-treating is being circulated by The Induction Heating Corp., 389 Lafayette St., New York, N. Y.

INDUSTRIAL EQUIPMENT The Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago, Ill., has issued its Catalog No. 22-A of automotive and industrial equipment.

METALWOVE BELTS Specifications and styles of metalwoven belts are listed in a 44-page catalog, published by Audubon Wire Cloth Corp., Richmond St. & Castor Ave., Philadelphia, Pa.

MOLYBDENUM STEELS Molybdenum high speed steels are discussed in a 6-page booklet of the Climax Molybdenum Co., 500 Fifth Ave., New York, N. Y.

PLATING TEMPERATURE CONTROL The Foxboro Co., Foxboro, Mass. is circulating a folder on automatic temperature control in electroplating processes.

PROTECTIVE COATING Protective coatings, including synthetics, specialties and rubber, are described in a new booklet just issued by Protective Coatings, Inc., 10391 Northlawn, Detroit, Mich.

SELF LOCKING NUTS How self-locking elastic stop nuts work and reasons for using them are listed in a folder released by the Elastic Stop Nut Corp., 2330 Vauxhall Rd., Union, N. J.

SHEAVES Steel and cast iron Sheaves for Texrope drives from fractional to 25 hp. are presented in a bulletin, B-6047, which was issued recently by the Allis Chalmers Mfg. Co., Milwaukee, Wis.

SLEEVE BEARINGS Federal-Mogul Corp., Shoemaker and Lillibridge Sts., Detroit, Mich., has published a cloth-bound "Handbook of Sleeve Bearings" prepared by Albert B. Willi, the company's chief engineer. Written as a practical guide for the engineer, designer and draftsman in the selection, design and application of sleeve bearings, this volume discusses the effect of design, alloys and manufacturing method upon sleeve bearing efficiency. Also, it defines the field of application for each basic type of sleeve bearing and lists innumerable sizes and types of bearings and bushings for which major manufacturing tools are now available. Published in a limited edition, this Handbook is available at no charge to engineers whose products contain sleeve bearing installations.

SPEED REDUCERS Worm gears for speed reduction are described by the Cleveland Worm and Gear Co., 3277 E. 80th St., Cleveland, Ohio, in an eight-page booklet entitled "Background."

THREAD GRINDING A 6-in. precision thread grinder is described in a folder recently published by Landis Machine Co., Waynesboro, Pa.

TOOL TIPS Firth-Sterling Steel Co., McKeesport, Pa., has brought out a new catalog and price list of standard tool tips. A section on non-standard tips is included.

VIBRATION DATA Data Sheet No. 10 giving technical information on "Vibration Isolation with Felt" has been released by the American Felt Co., Glenville, Conn.

Manufacturers Look to Steel Warehouses for Quick Defense Requirements

Many leading manufacturers are relying on nearby steel-service plants for prompt, stock shipment of steel to meet the current surge of business prompted by our National Defense Program.

Probably the leading exponent of "Immediate Steel" is Joseph T. Ryerson & Son, Inc., with their net work of ten strategically-located plants, each of which is completely equipped for prompt service on steel and allied products, formed and cut to customers' exact requirements. No shop should be without the Ryerson Stock List (see advertisement below).

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Although the National Defense program and essential industries come first, we are putting forth every effort to serve all Industry to the best of our ability. Naturally, many sizes and certain products are out of stock. However, for the most part you can depend on Ryerson for immediate shipment of a wide range of steel products.

For best service during this period of heavy demand, "open" orders are advisable. Stock List sent promptly on request.

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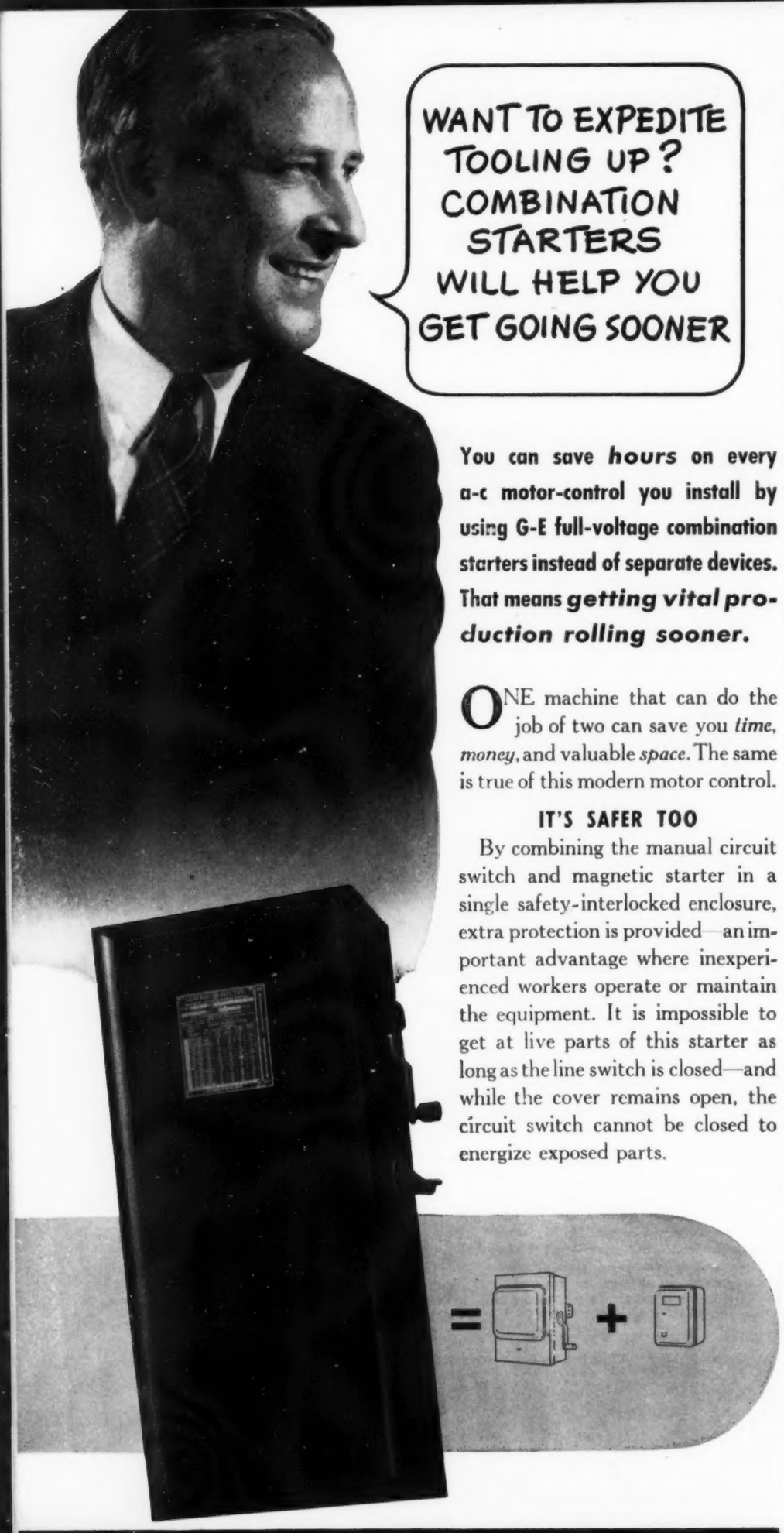

You can save *hours* on every a-c motor-control you install by using G-E full-voltage combination starters instead of separate devices. That means *getting vital production rolling sooner.*

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By combining the manual circuit switch and magnetic starter in a single safety-interlocked enclosure, extra protection is provided—an important advantage where inexperienced workers operate or maintain the equipment. It is impossible to get at live parts of this starter as long as the line switch is closed—and while the cover remains open, the circuit switch cannot be closed to energize exposed parts.

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NEW BOOKS

TOOL DESIGN—*By Charles Bradford Cole, consulting mechanical engineer and president, Tool Equipment Sales Company.* 498 *pages. Published by American Technical Society, Drexel Ave. at* 58*th St., Chicago, Ill.* $4.50.

Tool designing has become one of the most important factors in our present industrial structure. Without proper tools it would be impossible to produce practically all of the metal articles in wide use today in our everyday life. Our present automobile, railroad, airplane, business machine, and other large metal-working industries would be impossible without the mass production methods made feasible by the machine and tool designers that our industrial system has developed.

Recognizing today's needs for many more tool designers than are available, the author has incorporated in this volume fundamental principles of design as applied to tooling for production, so that the book is of value both to the student, and to the practicing tool designer who desires to increase his fund of knowledge on the subject. A total of 425 photographs and line drawings serve to illustrate the book, and at the end of each chapter there are a number of questions which bring out the principal points made in that chapter. Separate chapters are devoted to materials, design standards, commercial standards, cutting tools, production tools, drill jigs, fixtures, dies and gages.

•

EFFECTIVE FOREMANSHIP — *Edited by Harold B. Maynard, President, Methods Engineering Council.* 263 *pages. Published by the McGraw-Hill Book Company,* 330 *West* 42*nd St., New York City.* $2.50.

There was a time when some self-styled experts on shop management thought that the best way to promote efficiency was to decentralize the foreman's functions. What they meant by this was to take away a good many of his former duties and put them in the hands of "functional groups". Time proved that they were on the wrong track. The foreman has always been a key man and will always continue to be so long as he is the main contact between management and the shop operators. True enough he needs technical assistance from specialized departments set up to study the many problems of management, but after all, these are service departments which can do the most good by supplying the foremen with information instead of trying to usurp his powers.

The present volume, properly enough, devotes itself to making foremanship more effective. It is the work of not one but 18 authors, each of whom has contributed one or more chapters to make a well-rounded contribution to

the techniques of management. The editor, Mr. Maynard, has contributed chapters on "Effective Working Methods" and "Operator Training" in addition to an introduction to the volume. Other contributors are for the most part in managerial or personnel relations positions in large industrial plants, or members of university faculties engaged in the teaching of industrial management. One contributor, Captain Donald E. Farr, Corps of Engineers, U. S. Army, has written a chapter on the "Effect of Orderliness on Production."

The book is so arranged that it may be used to adavntage by the individual foreman, whether he is new to his duties or of long experience. It may be used in connection with conferences of foremen as it is arranged with questions for discussion accompanying each chapter. At this time when supervisory training is much in the forefront, a volume of this kind may serve as a basis of a course to develop the industrial leadership so needed today.

•

MECHANICAL ENGINEERS' HANDBOOK—*Edited by Lionel S. Marks. Gordon McKay Professor of Mechanical Engineering, Emeritus, Harvard University. Fourth Edition.* 2274 *pages. Published by McGraw-Hill Book Co.,* 330 *W.* 42*nd St., New York, N. Y.* $7.

This revised edition of Marks' Handbook endeavors to present both fundamental theory and the data of experiment and experience in that range of subjects which is usually covered by the mechanical engineer. While intended primarily for engineering students and practicing engineers, the subject matter is so presented as to be of value to any mechanically-minded and intelligent layman confronted with simple engineering problems.

During the eleven-year interval since the appearance of the last edition, great advances have occurred in practice, in theory, and in the systematization of existing knowledge in the field of the mechanical engineer. In addition, the period has been one of active standardization of machine elements, of materials and of processes by engineering societies and other organizations. The new edition attempts to include the more important parts of this material.

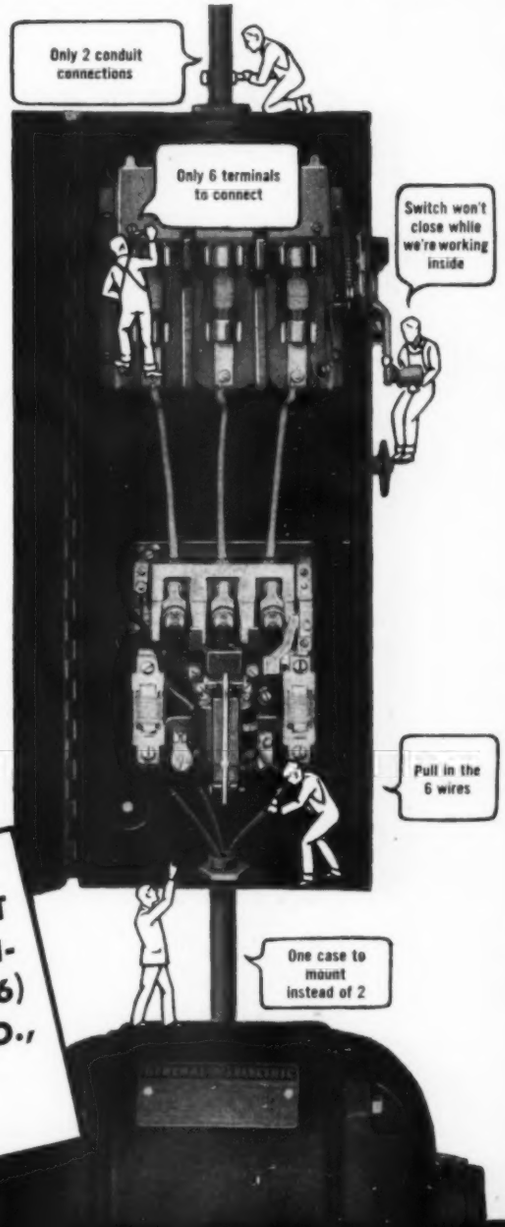
Among the new subjects are the theory of models, plastic behavior of materials, stress concentration, creep, packings, wind pressure on structures, sound and noise, automatic control of processes, and powder metallurgy. It has been necessary to rewrite completely most of the sections in order to incorporate in them the new knowledge and the new points of view. A special effort has been made to avoid further expansion of this already large book. This has been accomplished, notwithstanding the large amount of new material, by exclusion or condensation of matter which has become, or is in the process of becoming obsolete.

The increasing complexity of the

Combination starters are taken out and re-installed more quickly than separate devices. That's why they multiply savings on changeover.

AUTOMOTIVE manufacturers have long recognized that the right control for them is the control that has everything in one "package." That's because, with mass-production methods, they periodically change over their equipment to re-adapt it to changing demands. It's especially during this changeover period that savings are made—you make the original installation savings all over again each time the motor, or control, or machine is relocated.

Do as the leading automotive manufacturers do—use G-E combination starters for your new plant equipment. Your G-E agent or the nearest G-E office can give you full information.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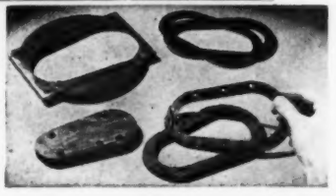
Cutting gaskets—generally a pain in the neck—is easy with a DoAll. The paper is screwed between two plates, the cut made through the plates, maintaining smooth edges on gaskets.



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Takes the place of shaper, milling and lathe work on hundreds of different jobs in large and small defense and industrial plants everywhere. In addition to internal and external sawing, the DoAll does band filing and polishing.

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field of mechanical engineering is reflected in the increase in contributors, who now number over 90. These contributors have been selected for their special competence in particular fields. Altogether, about 100 engineers and scientists have worked on this book. The book is divided into 16 sections, and is indexed carefully for quick reference to any subject covered. Line drawings and tables are used throughout the text to illustrate points made, and to incorporate as much data as possible in the pages.

Tool Steel Round-Up

Besides the pressure of orders, one of the reasons why tool shops have fallen behind on deliveries is the delay in obtaining high-speed steel. Many an urgently needed tool for national-defense production has been held up through lack of the proper shape or size of material.

Recently a large amount of high-speed steel was put to good use in the Detroit area by gathering waste ends from plants making broaches. The long, heavy broaches used by the automotive industry require heavy forged bars, and the waste ends left after cutting off a sufficient length for the tool often amounts to a considerable poundage. In one shop alone, several tons of waste ends accumulated.

This material was gladly sold to other plants when it was made clear that much of the material could be worked up directly into small tools or easily reforged by job shops into suitable blanks. Perhaps a search of shops in other areas will uncover idle pieces of high-speed steel that can either be used in the plant after reworking or sold to other shops in the community. Considering the load upon the producers upon high-speed steel and the need for conserving alloys, the idea might be worth a try.

Job-Analysis Books

In building an organization to cope with an entirely new type of product—aircraft wings and other components—The Briggs Manufacturing Company has found job-analysis books of inestimable value in training workers. The aircraft division started in the summer of 1940 with four executives who knew the details of aircraft manufacture; by October 1941, more than 2500 workers were on the payroll.

Training was attempted in the shop but has been changed to the vestibule school system, where 60 instructors are training 900 operators to attain quality under conditions which the qualified trainee will find in the shop. Each assembly has been broken down into its job elements and an operator is trained for each task.

Here the job-analysis book comes into play. If a wing-tip assembly, for ex-

ample, the book devotes two facing pages to each operation in sequence. The left-hand page for each operation consists of a full-page action photograph of the job, showing machine or tool, the work and how the operator goes about the task. The right-hand page gives a written analysis of the operation, job procedure and requirements. Pages are assembled in a spiral binding so that the book will open flat on the bench to the desired operation.

Some persons might think that such training aids are expensive. The point is that it costs money to train young men who have never had any previous job experience, or to convert auto workers to tasks totally unlike their normal pursuits. If the training time can be cut down from 60 to 30 days or less, training aids such as these job-analysis books are worth the expense many times over. Besides, with additional thousands of persons to be trained for the aircraft activity, it is desirable to have known standards in existence, so that the entire organization will continue to hew to the line and produce material that will pass rigid government inspection.

Shell Machining Problems

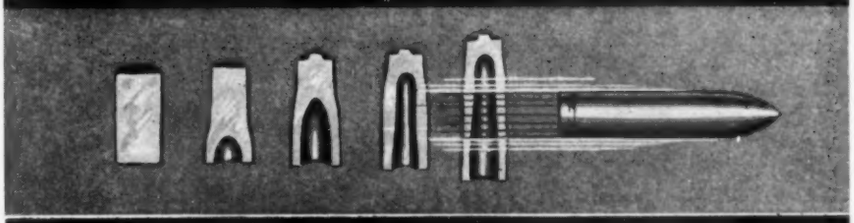
By BEN C. BROSHEER

In most set-ups for shell machining operations it takes too long to replace and reset dull or broken tools, or to change a set-up for another size shell. Whether a single tool or several tools are used in a machine, much time can be saved by applying magazine-type toolholders into which single-point tools can be set, positioned and ground to standard gages in the toolroom, then taken to the machine and positioned against stops on the carriage in a matter of seconds. The closest limit for a shell dimension is 0.005 in. and most dimensions have much broader limits. It should be a simple matter to position a magazine holder within 0.001 in., even with green operators. Otherwise, each tool change in the machine involves setting the tool to height and diameter in relation to other tools in the set-up, and usually requires several trial cuts. Although permissible under ordinary conditions, such excessive set-up time cannot be justified in the production of shell—further, skilled set-up men are scarce and could be used to better advantage elsewhere.

The success of a set-up for machining shell depends to a large extent on the careful selection and maintenance of the cutting tools, whether they be made of high-speed steel, Stellite, or one of the steel-cutting carbides. In no case should a machine operator be permitted to grind his own tools—his job is to keep his machine running to get shell off the end of the line as rapidly as possible. A central toolroom should be provided for grinding tools.

Also, several complete sets of cutting tools should be provided for each ma-

SHELLS a-poppin'



A 90 mm. shell forging from a machine every 12 seconds with the help of "dag" colloidal graphite is a recent report. ❖ ❖ A new shell forging lubricant containing "dag" colloidal graphite is now available nationally from major oil companies. ❖ ❖ Write for Technical Bulletin No. 230S entitled "Colloidal Graphite Dispersions."

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1558

chine. The operator should have at least one set of ground tools ready for installation should the set in use become dull or broken. There should be two or three more sets either in the toolroom being sharpened or enroute between the machine and the toolroom. In no case should the machine operator be required to leave his machine to secure a set of tools—they should be delivered to him by a tool chaser.

In most instances American shell machining contractors are awake to the possibilities of employing roller and overhead monorail conveyor systems in shell machining lines. In many cases spool-type roller conveyors have been used for moving the shell bodies from operation to operation; in others, special hangers have been developed for monorail systems. No matter what system is used, every effort should be made to reduce lifting to a minimum. Shell bodies, especially of the larger sizes, have some weight and by the time he has finished his trick each day the operator of a machine in a shell line has lifted a lot of metal into and out of his machine. Some builders of shell-turning machines have incorporated transfer units in their machines, so that the operator has only to slide the forging from the conveyor onto a tray or rails and then push it into place on the arbor or in the chuck. In most cases nothing has been attempted along this line, and where larger sizes of shell are being machined some consideration should be given such aids.

Shell machining contractors handling large quantities have another problem for which conveyors have served well in other industries. That is the problem of handling chips. Where shell are being machined in any quantity, the problem of chip disposal is as important as the problem of transferring shell from one operation to the next. Not only must the machines be arranged so that chips easily can be removed to trucks or conveyor lines, but arrangements for transportation of the chips through the plant must be provided. Under-floor conveyors have been used in peace-time plants to advantage—and it would seem that a similar arrangement would be particularly applicable in shell machining lines.

This problem of chip disposal brings up again that of securing forgings with a minimum of excess stock. Every extra pound of metal on each shell in a lot of 2,000 means that a ton of excess metal must be removed by the tools and then transported back to the steel mill for remelting. This extra handling, while of direct importance to the shell machiner, is of even more importance to the armament program—since every ton of steel misused means another ton taken from some other important defense project and an extra burden on an already overloaded steel industry.

Abstracted from talk delivered at meeting on shell manufacture at National Metal Congress.

Flying Chips Take Horsepower—Discussion

By J. C. DAVIES
Birmingham, England

If the simple but essential suggestions given in the article, "Flying Chips Take Horsepower," by John Lawrence (*AM*—Vol. 85, page 378) were followed, most of the breakdowns experienced by users of tungsten carbide cutting tools would be eliminated.

The portion of this article relating to power consumption is described as "difficult to understand," and the impression is given that a high-speed steel cutting tool cuts more freely than a tungsten carbide tipped tool. An example is given to prove this statement. My contention is that of two cutting tools ground with the same rake and clearance angles, the tungsten carbide tool would have a slight advantage due to the diamond-lapped face over which the chip must pass, as compared with the softer and not so finely lapped high-speed steel cutting tool.

The example given of high-speed steel cutting tools requiring 15.1 hp. when turning at 63 ft. per min. with 0.024 in. feed and a ¼-in. depth of cut, and of cemented carbide cutting tools taking 74.4 hp., when cutting at 310 ft. per min., with the same feed and depth of cut on the same job, shows an almost constant ratio of 5 to 1 between the surface speed and horsepower required, with a slight advantage in favor of high-speed steel cutting tools. However, as the machine operating at the lower surface speed has the advantage of 5 to 1 gearing, the power consumption is similar for both sets of cutting tools, with the exception of the "slight advantage in favor of the high-speed steel cutting tools" mentioned above. This slight loss is easily accounted for by the increased speed at which the headstock gearing and spindle must run, with the consequent increase in friction.

A true test with similar conditions, i.e., rakes and angles cutting tools, surface speed, feed and depth of cut, would, I think, prove the above remarks correct.

Cost of Crating

Unless one is familiar with the cost of preparing heavy machines for shipment, it is wise to study it carefully before giving an estimate that includes delivery for shipment. Heavy timbers for skids and suitable scantlings for frame and braces, can run into a lot of money. And when a fine machine has to be completely boxed for sea shipment, including a lining of water-resisting paper, there are more troubles for the estimator. It would be rather startling to have a good share of the profit on a machine disappear in the cost of crating it for shipment.

Standard conveyor engineers, through sound recommendations, based on more than thirty years of conveyor experience throughout industry, have helped hundreds of manufacturers to make man-power and man-hours more productive. Typical installations like those described below give you an idea of what Standard Conveyor engineers may be able to do for you:

PROMINENT FOOD MANUFACTURER REPORTS:

". . . one of the greatest time and labor-saving devices we have ever used—paid for itself in less than 12 months."

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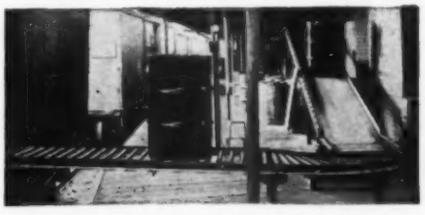
Standard Conveyors used in large plant for fast, safe "line" production of 3 inch A. A. shell.

OIL REFINERY SAVES FIRST INVESTMENT

in Conveyors—$6,501 A Year. ". . . new equipment must justify itself within first year . . . the conveyor has paid for itself within that time. Additional conveyors have been purchased each year since first conveyors were installed."



Booklet Shows Conveyor Applications and Possibilities

Send for booklet AM-11 "Conveyors by Standard"—a valuable reference book on conveying and conveying methods—contains many installation pictures representing practically all industries—suggests type of conveyors best suited to particular products and commodities.

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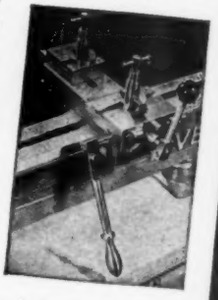
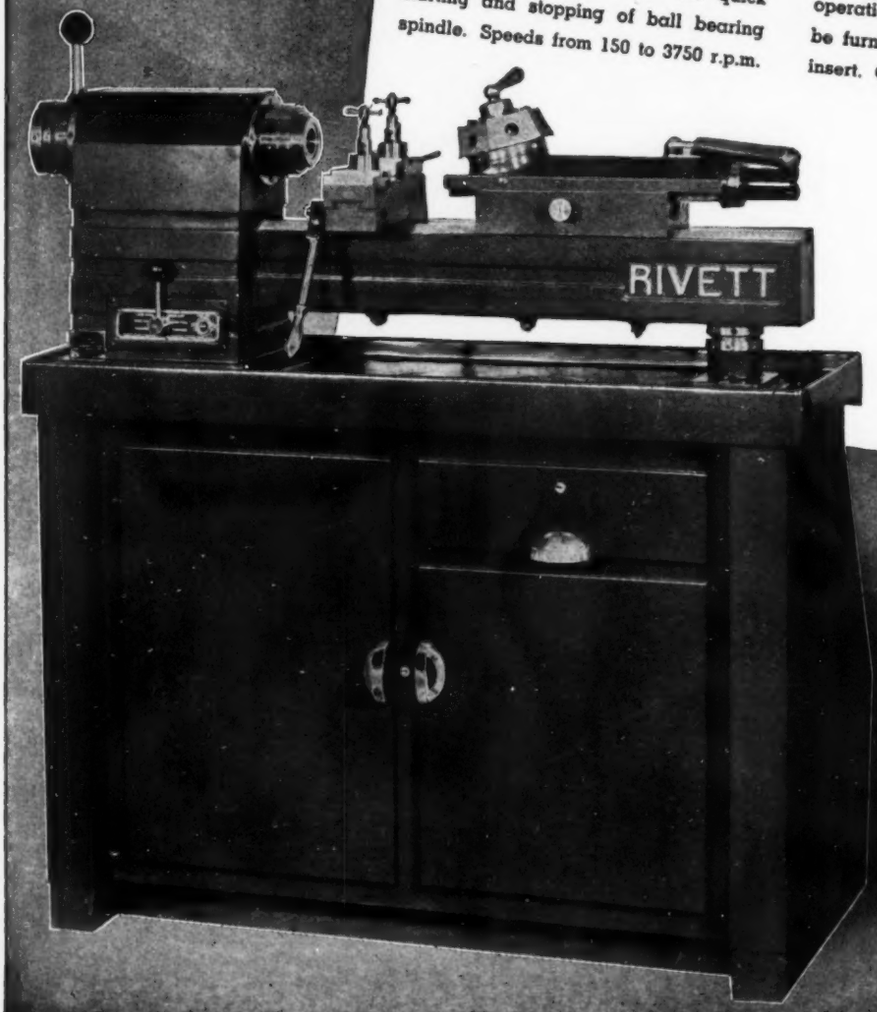
The balanced design and operating features of the Rivett 918 hand screw machine make it an efficient producer on small precision parts. Work is accurately held in collet operated by rotary chuck closer with ball thrust bearing. Single lever controls lathe drive and automatic brake for quick starting and stopping of ball bearing spindle. Speeds from 150 to 3750 r.p.m. can be selected. Automatic indexing turret head revolves on roller bearings and is geared to independent stops. Cross slide carries tools for forming and cutting off. The machine is free from all vibration as it is properly proportioned and dynamically balanced throughout.



Parts requiring up to eight operations can be finish-machined at one chucking. Bar stock passed through spindle can be held in push-out collets up to 1" capacity while work individually chucked can be held in draw-in collets, step chucks or jaw chucks. If a turning operation is required, cross slide can be furnished with a parallel slide; see insert. Oil pump and piping is optional.

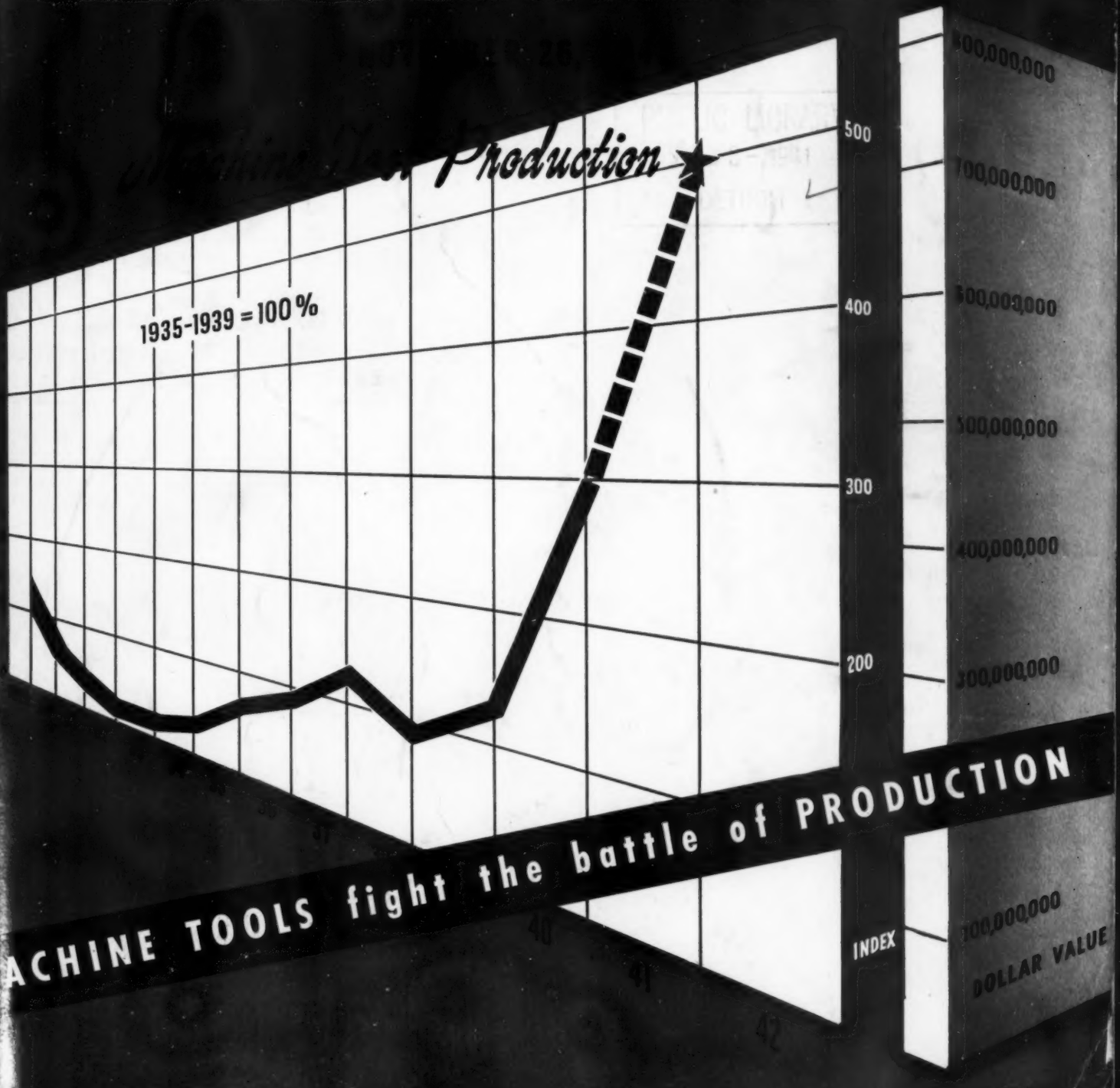
For complete information write for Bulletin 918



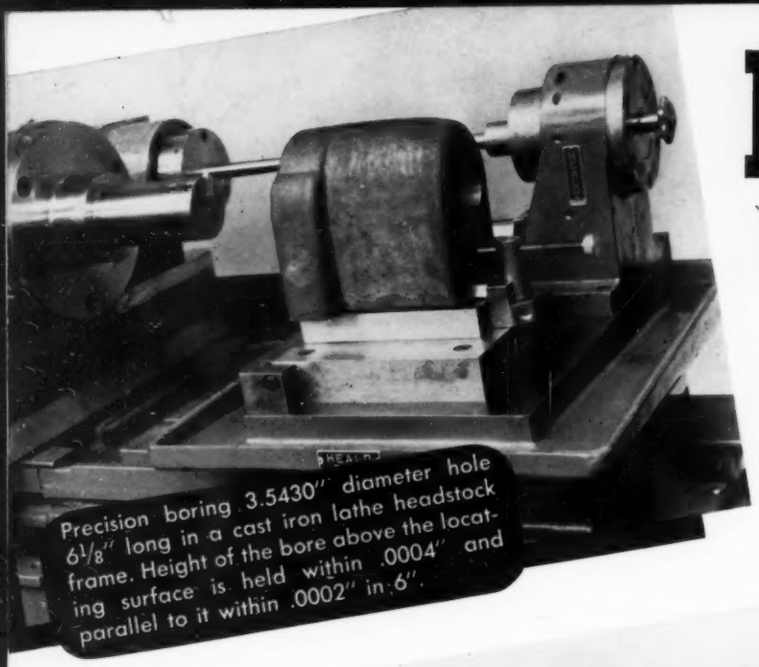
918 hand screw machine on metal cabinet with eight spindle speed drive.

RIVETT LATHE & GRINDER INC.
BRIGHTON, BOSTON, MASS.

AMERICAN MACHINIST



MACHINE TOOLS fight the battle of PRODUCTION



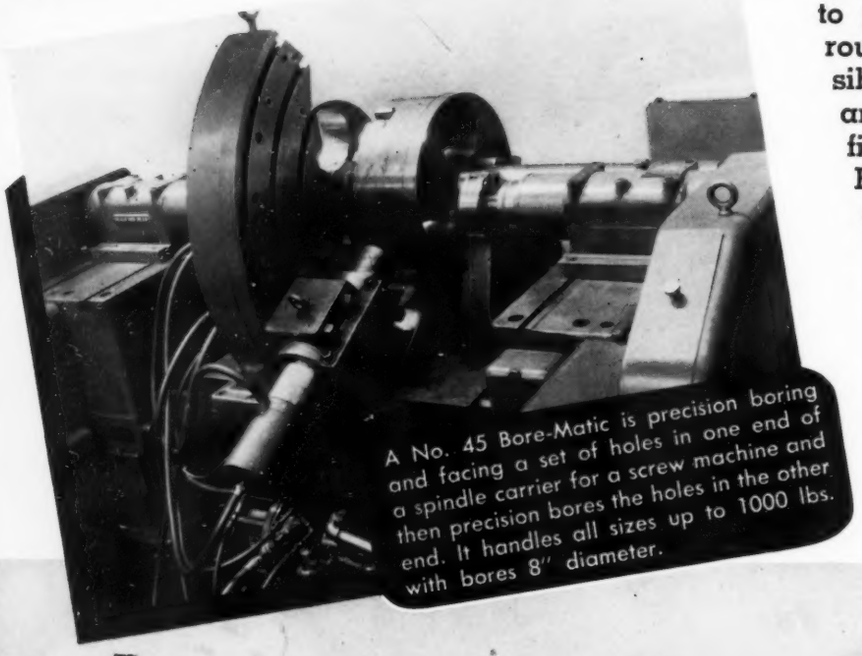
Precision boring 3.5430" diameter hole 6 1/8" long in a cast iron lathe headstock frame. Height of the bore above the locating surface is held within .0004" and parallel to it within .0002" in 6".

PRECISION Keeps them PRODUCING

Boring, facing and turning with single point tungsten carbide tools in a Heald Bore-Matic has done much to raise the precision level of modern machine tools and keep them operating during the present severe production schedules.

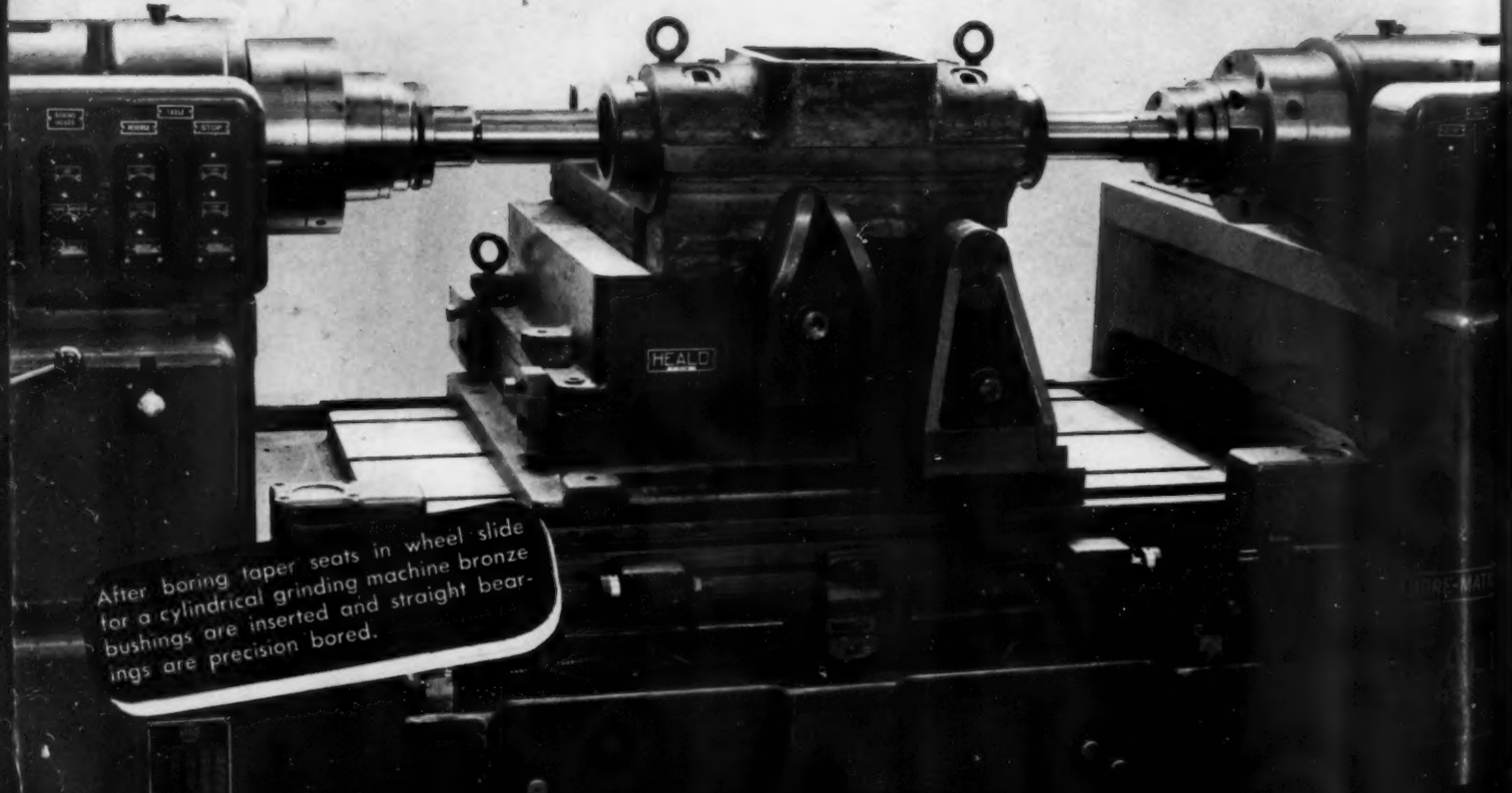
Advantages of this method lie in the ability to produce very close accuracy for size, roundness and straightness and makes possible the obtaining of perfect alignment and absolute squareness of hole with a finished surface.

Heald Bore-Matics will be found throughout the machine tool industry finishing vital units such as pump parts, lathe head and tail stocks, bearing seats in workhead bodies, valve bodies, bearing sleeves, carriers, etc.



A No. 45 Bore-Matic is precision boring and facing a set of holes in one end of a spindle carrier for a screw machine and then precision bores the holes in the other end. It handles all sizes up to 1000 lbs. with bores 8" diameter.

The HEALD Machine Co.
Worcester, Massachusetts
GOOD MACHINISTS SINCE 1826



After boring taper seats in wheel slide for a cylindrical grinding machine bronze bushings are inserted and straight bearings are precision bored.